# SUMMARY REPORT

OF THE

# DEPARTMENT OF MINES

## GEOLOGICAL SURVEY

FOR THE CALENDAR YEAR

## 1907

*PRINTED BY ORDER OF PARLIAMENT*

OTTAWA
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1908

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*To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey, Viscount Howick, Baron Grey of Howick, a Baronet, G.C.M.G., &c., &c., &c., Governor General of Canada.*

MAY IT PLEASE YOUR EXCELLENCY,—

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII., chapter 29, section 18, the Summary Report of the operations of the Geological Survey during the year November 30, 1906, to November 30, 1907.

WILLIAM TEMPLEMAN,
*Minister of Mines.*

Hon. Wm. Templeman,
Minister of Mines,
Ottawa.

Sir,—I have the honour to submit herewith the Acting Director's Summary Report of the operations of the Geological Survey during the year November 30, 1906, to November 30, 1907.

I am, sir,

Your obedient servant,

J. F. WHITEAVES,
*Acting Deputy Minister.*

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# SUMMARY REPORT

OF THE

# GEOLOGICAL SURVEY OF CANADA

## FOR THE CALENDAR YEAR 1907

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J. F. WHITEAVES, Esq.,
Acting Deputy Minister,
Department of Mines.

SIR,—As Acting Director I have the honour to submit, herewith, the Summary Report of the Geological Survey of Canada for the Calendar year 1907.

The prompt publication of last year's Summary Report—which was issued within ten days of the close of the year—elicited favourable comment from the daily and scientific press of the Dominion. Such speedy issue is only possible if the maps and plans, which, for some years, have accompanied the Survey's Summary Reports, be discarded. But, the manner in which last year's report was received by the press and public, leaves no doubt that prompt publication, without maps and plans, is preferred to the later issue, with those accessories included. On this account, it has been decided to again publish the report at the earliest possible moment, that is, directly the field officers are able to furnish an account of their season's work.

The scheme, inaugurated by Dr. Low last season, of distributing free of charge to *bona fide* applicants in Canada, any report that might prove of economic or scientific interest, has met with marked success. Applications for the Survey's reports have been much more numerous, with the result that the work done by this Department is becoming better known and more widely recognized. For two of the most detailed reports issued by the Survey of recent years, namely the report on the region west of Lake Timiskaming, and the Bulletin on Nickel, there was so large a demand that the editions entirely ran out, and it became necessary to order reprints. Owing to the decision to bring the accompanying maps up to date, both geologically and topographically, the issue of these reprints has been unduly delayed, but the Bulletin on Nickel was published a few days ago and the Timagami District report should appear in January.

The problem of quickly supplying the interested portion of the public with the information collected by the Survey is one of considerable difficulty, but the efforts, outlined in last year's Summary, to secure both greater promptness in the publication

of such information and the efficient distribution of the same, have been marked by encouraging success and warrant further endeavour along similar lines.

### VICTORIA MEMORIAL MUSEUM.

In view of the early completion of this museum, efforts are being made by this Department to procure specimens of some of the larger and rarer mammalia, &c., of the Dominion. Mr. Joseph Keele, who is wintering on the Upper Pelly river, has been particularly instructed to obtain representative specimens of the northern mammalia, and advices received from him before the winter set in report that good fortune had attended his efforts. Arrangements are also being made to secure specimens from other districts.

### THE MINERAL INDUSTRY.

Particulars of the mineral production of Canada, which have heretofore been published in this report, will be found in the report of the Mines Branch to which the mining statistical staff has been transferred.

The activity in the mineral districts of Canada during the past year, noticeably in the region about Cobalt and northward to and along the line of the Grand Trunk Pacific railway, has resulted in a pressing demand for geological information concerning these districts. The northern part of the provinces of Ontario and Quebec and the central portion of British Columbia are now calling for a large amount of geological investigation. New Brunswick and Nova Scotia are also demanding that more attention be given to the development of their natural resources. This rapid opening up of the country, and growth of the mineral industry, must be met by a corresponding increase in the activity of the Geological Survey. To meet this growing demand for geological information, an increase in the appropriation for the Survey and an addition to the strength of its technical staff are urgently needed.

### FIELD ASSISTANTS.

The system, inaugurated last year, of employing as field assistants, chosen students from the scientific schools of Canada worked very satisfactorily and promises well, both for the Geological Survey, which gains promising recruits for future employment, and for the men themselves, who are enabled to obtain practical experience in the field while pursuing their college courses.

### MINERAL COLLECTIONS FOR EDUCATIONAL INSTITUTIONS.

The improved educational collections of minerals enclosed in suitable cabinets, the distribution of which to the High schools of the country was begun last year, have been highly appreciated by the communities into which they have gone and their educational value will be very great. The arrangement and distribution of similar collections will be continued in the coming year. Particulars of this distribution will be found on a later page.

### THE LABORATORY.

In the chemical laboratory the operations were conducted by Dr. G. C. Hoffmann, up to the time of his retirement on April 1, assisted by Mr. F. G. Wait ; and since that date by Mr. F. G. Wait, assisted by Mr. M. F. Connor.

The specimens submitted to examination have been of the same varied character as in former years, and, in reporting upon them, an endeavour has been made to make the results as practical as possible.

### GENERAL INDEX.

The General Index of the Survey's publications, which is a continuation of the Index brought by Mr. Dowling up to 1884, went to press in May and is now very near completion, 960 pages out of a probable 1,050 having been struck off. The compiler has included in the work a great deal more than the contract rendered compulsory, with the result that the usefulness of the book has been very largely enhanced. The scheme of this Index, with its sub-divisions handled in such a manner as to assure references being easily found, is excellent, and the typography, so essential a feature in a book of this kind, is one of the best pieces of work ever turned out by the Printing Bureau.

### WORK ON TERTIARY PLANTS OF BRITISH COLUMBIA AND WESTERN CANADA.

During the past year Dr. Penhallow received from Mr. L. M. Lambe, of the Geological Survey, a very extensive collection of Tertiary plants from various localities in British Columbia. The study of this important material necessitated a complete review of all the work previously done with respect to the Tertiary flora of Western Canada, embracing that already reported upon by Sir William Dawson with respect to the Lignite Tertiary of Saskatchewan and Mackenzie river, as well as the work of Heer, and the study of plants derived from British Columbia. The floras thus surveyed have been co-ordinated with the work of Lesquereux, Newberry and others, upon the Tertiary floras of the United States. There has also been brought under consideration a detailed discussion of the cause of the combustion of beds of lignite. In both of these respects conclusions have been reached which seem to offer satisfactory explanations and which establish the probable positions of the various Tertiary beds in Canada.

It has been found that, so far as explored, all of the Tertiary rocks belong to horizons which extend from the Lower Eocene to the Oligocene, or possibly to the Lower Miocene.

### INTERNATIONAL COMMITTEE ON CORRELATION OF THE PRE-CAMBRIAN ROCKS.

Reference was made in last year's Summary Report to the progress of the work of the International Nomenclature Committee, consisting of Mr. F. D. Adams, A. E. Barlow, A. P. Coleman, H. P. Cushing, J. F. Kemp and C. R. Van Hise, and it was stated that a report by the committee would be shortly issued.

The report, under the title 'Report of a special committee on the correlation of the Pre-Cambrian rocks of the Adirondack mountains, the original Laurentian area of Canada and Eastern Ontario,' was published in the Journal of Geology, Vol. XV., No. 3, April-May, 1907.

After a resumé of the geology of each area the following conclusions are published as the recommendations of the committee covering correlation and nomenclature.

RECOMMENDATIONS OF THE COMMITTEE CONCERNING CORRELATION AND NOMENCLATURE.

"The committee considers that over the whole area covered by their investigations—namely, the Adirondack mountains, that portion of Eastern Ontario which they examined, the 'Original Laurentian areas' in the province of Quebec and its continuation to the east as far as the River St. Maurice—the Pre-Cambrian sedimentary development is represented by one great series. This series is essentially identical in petrographical character throughout the whole region.

The only locality where the possible (Coleman would say probable) existence of a second unconformable sedimentary series was sugggested by the facts observed, was that on the Queensboro road, east of Madoc, Ontario. It is, however, still a matter of uncertainty as to whether the conglomerate here developed marks the base of an overlying, infolded, unconformable series or not.

In Logan's original classification of the Laurentian this term—apart from the Upper Laurentian which was proved to be composed essentially of anorthosite intrusions—included two series differing in character, namely, the Lower Orthoclase (Fundamental Gneiss) and the Grenville series. Now that investigations have shown that these two series differ in origin, one being essentially a great development of very ancient sediments, and the other consisting of great bodies of igneous rock intruded through them, it becomes necessary to separate these two developments in drawing up a scheme of classification.

As the great intrusions of gneissic granite, forming what has been termed the 'Fundamental Gneiss,' have an enormously greater areal development than the overlying sedimentary series, constituting, as they do, a very large part of the whole northern protaxis, the committee recommend that the term 'Laurentian' be restricted to this great development of igneous gneisses. The nomenclature suggested for the Pre-Cambrian rocks of this eastern region will thus conform, so far as the use of this term is involved, with that suggested by the Special Committee for the Lake Superior region.'

For the overlying sedimentary series the committee recommend the adoption of the name 'Grenville series,' as it is the name originally given by Logan to the series as typically developed about the township of Grenville in the 'Original Laurentian area' on the north shore of the Ottawa river, in the province of Quebec, between the cities of Montreal and Ottawa. The term 'Hastings series' in the opinion of the Committee should be abandoned as a serial name, seeing that the development to which this name was applied by Logan is merely the Grenville series in a less altered form, as Logan in giving the name had conjectured was probably the case. The committee, however, think that it may in some cases be advantageously employed as a qualifying term to designate the less highly altered phase of the Grenville series, which may thus be referred to as the 'Hastings phase' of the Grenville series.

In Canada this Grenville series everywhere on going north is invaded by and frays away into the great Laurentian batholiths, while in the Adirondacks it is cut to pieces by the great intrusions of that area which, when worked out in detail, may prove also to have a more or less similar batholithic form.

The following succession in this region is therefore recognized and adopted by the committee :—

Cambrian—Potsdam sandstones, &c.
(Unconformity).
Pre-Cambrian, Grenville series.
(Intrusive contact).
Laurentian.

The committee consider that it is inadvisable in the present state of their knowledge to attempt any correlation of the Grenville series with the Huronian or Keewatin, so extensively developed in the region of the Great lakes. The Grenville series has not as yet been found in contact with either of these, and until this has been done

and the relations of the several series have been carefully studied, their relative stratigraphical position must remain a mere matter of conjecture."

## WORK OF THE FIELD OFFICERS.

There were in the field, last season, 20 parties. In addition to the regular officers of the Survey, 3 gentlemen were engaged for the summer on special work, namely:—Messrs. Hunter, Bancroft and Dresser.

The following is a short synopsis of the work performed in the field. It is followed, as usual, by the Summary reports of the field-officers themselves.

With the exception of a short period spent in the Rocky mountains, Mr. R. G. McCONNELL was engaged in investigating the geology and economic features of the copper-bearing rocks in the vicinity of Whitehorse, Yukon. In this work he was assisted by Mr. Maclaren, topographer, who obtained data for and is now compiling a contour map of the district. Mr. Haughton acted as geological assistant. A report on the district, illustrated by maps and sections, is now being prepared and will be sent to press shortly.

Mr. D. D. CAIRNES continued his explorations in the southern portion of the Yukon, chiefly between Whitehorse and Tantalus, where coal and copper were being largely developed. The serious fall in the price of copper will temporarily, at least, retard mining in this district.

Mr. JOSEPH KEELE was commissioned to make an exploratory investigation of a hitherto little known region situated for the most part between lats. 62° and 63°, but which also includes that portion of the Yukon drained by the Upper Pelly and its tributaries, the Hoole, Ross and Kitza rivers.

Mr. Keele, who is wintering on the Upper Pelly, writes that he can find no trace of the existence of an active volcano that prospectors, returning from this district, have reported among the mountains near the source of the Pelly.

Mr. J. AUSTEN BANCROFT was engaged to explore that portion of the coast of British Columbia extending from Powell river to Kingcome inlet, including the adjacent islands. This survey is a continuation of that carried on by Mr. O. E. LeRoy during the summer of 1906. At the time of Mr. Bancroft's visit a considerable amount of copper prospecting was in progress.

Mr. W. W. LEACH continued his investigations in the Bulkley valley. He reports that of the comparatively few new mineral locations taken up, the majority are situated on the headwaters of the Zymoetz river or in the Babine mountains.

Work on the coal properties of the Telkwa river has practically been stopped until the route of the Grand Trunk Pacific has been definitely decided on. Several new areas of coal land have been discovered, one in particular on Goldstream giving promise of becoming of importance.

Owing to the wrecking of all the steamers on the Skeena provisions were scarce and expensive, adding much to the difficulties of prospecting.

Mr. CHARLES CAMSELL was engaged entirely in work of an economic nature in the gold mining camp of Hedley, B.C. The Nickel Plate mine at Hedley is the most important mine in this part of southern British Columbia, and is at present the largest producer of gold alone in the whole province. Besides preparing a topo-

graphical map of the camp, the geological work was devoted primarily to a study of the ore deposits and the examination of mineral claims. It is hoped to complete this work early next season.

The WRITER and Mr. W. H. BOYD were employed in extending the mapping of the Lardeau district and in completing the 1,200 foot sheet of the Rossland camp. Mr. Boyd also paid a visit to the Similkameen district to start a topographical survey of that region.

Mr. D. B. DOWLING was mainly engaged in obtaining more details of the coal areas north of the Saskatchewan river, where he had discovered several seams of coal the previous season. He also made an examination of the Athabaska valley.

Mr. G. S. MALLOCH was engaged in completing the photo-topographic survey of the Cascade, Palliser, and Costigan coal basins, in which work he had been engaged while acting as Mr. D. B. Dowling's assistant in the previous year. The survey was carried northwest from Panther creek to the Clearwater river.

Mr. WILLIAM McINNES was instructed to make an exploration of the tract of country in the province of Saskatchewan lying south of the Saskatchewan river and north of the Prince Albert branch of the Canadian Southern railway. This was virtually an extension of the work done last year along the proposed Hudson Bay Railway route. Mr. McInnes reports large areas of very excellent agricultural land that is now not too far from a railway to be available for settlement. The interesting beds of bituminous shales referred to, though not, probably, where seen, of present economic value, may lead to discoveries of greater commmercial interest.

Prof. JOHN MACOUN spent six weeks in western Ontario collecting wood specimens and photographs of trees, and five weeks along the Gaspé coast collecting seaweeds.

Mr. W. H. COLLINS was engaged in a continuation of exploratory work along the National Transcontinental railway westward from Savanne lake for 130 miles. That area consists of Laurentian and Keewatin formations, the former containing feldspar and muscovite, the latter iron, pyrite, and free gold. The agricultural possibilities are fair in the southern portion and the timber is much more valuable than that of the country to the east.

Dr. ROBERT BELL was engaged in the region north of Sault Ste. Marie, and in the area comprised in the Mississagi sheet, in order to complete the topographical work and delineate the geological formations. This work was particularly necessary in order to finish the first surveys, which he made in that district some years ago.

Mr. A. F. HUNTER was employed in the district between Georgian bay and the Ottawa river, in tracing the high-level shorelines at 1,040 feet and 1,430 feet around the high ground in the vicinity of Algonquin park.

Mr. W. A. JOHNSON continued the mapping of the Simcoe and Peterborough area, on which only a small amount of work had hitherto been done by the Survey.

Apart from his work in connexion with the coal tests, mentioned in another part of this report, Mr. THEO. DENIS spent some time in the examination of mineral deposits and occurrences in the region covered by the eastern part of the Bancroft sheet of Drs. Adams and Barlow. This was done in order to fill some gaps in the

report on the region, which is now ready for the printer, and to bring up to date the information concerning the working mines and the mineral discoveries in the district.

Mr. Denis was particularly impressed with the possibilities of the marble deposits, from which a great many varieties of ornamental stones could easily be obtained along the northern part of the Central Ontario railway, between L'Amable station and Bancroft.

At the present time the building of large edifices is extensively going on in eastern Canada, and the attention of architects may, to great advantage, be called to the apparently unlimited supplies of various marbles which could be extracted for decorative purposes.

Mention may also be made of the large deposit of sodalite which is now being developed near the town of Bancroft. The company owning it will soon be in a position to put on the market a beautiful ornamental stone, of various shades of blue, which takes a very high polish and is eminently well suited for decorative purposes.

At the time of Mr. Denis' visit to the district, metalliferous mining was represented by the active operations of the Mineral Range Iron Company, at Bessemer, Hastings county, which is working an apparently important deposit of magnetite; and the Hollandia mine near Bannockburn, which was operating on a deposit of galena. Other mineral enterprises are in a latent state, and many deposits are being prospected and developed.

In August Mr. Denis made a short trip to St. Joseph de Pierreville to investigate a find of natural gas reported to the Department by Mr. J. Gladu, M.P. for Yamaska.

The superficial deposits are here very thick, rock being reached at 172 feet. The find consisted of an accumulation of gas under a bed of impervious hard clay, at a depth of eighty feet. Such deposits are, of course, short-lived at best, but there is little doubt that natural gas exists in the rocks that underlie many parts of the region of the St. Lawrence valley.

Mr. M. E. WILSON continued the examination of the region to the east of Lake Timiskaming, extending the surveys commenced last year to Lake Kipawa and Lac des Quinze. Though the geological formations are nearly identical with those of the silver-nickel-cobalt areas of the Ontario side of the lake, no minerals have been discovered in sufficient quantities to be of economic importance. Large areas of good agricultural land occur in the district and already support a numerous and prosperous farming community.

Mr. W. J. WILSON continued the examination of the country adjacent to the National Transcontinental railway from Bell river eastward to the Susie river. He reports green schists and diabase, probably of Keewatin age, on the Bell river and eastward for some distance. From the lower crossing of the Migiskan river and the National Transcontinental Railway line the rock is gneissoid-granite and gneiss, the latter being well foliated and highly garnetiferous from the headwaters of the Atik river to the Susie river. Small areas of good agricultural land were noted along some of the rivers. The forest in many places was destroyed by fire in 1906.

Mr. OWEN O'SULLIVAN explored the country along the National Transcontinental railway from La Tuque, on the St. Maurice river, to the headwaters of the Gatineau.

Mr. J. A. DRESSER, lecturer in Geology, McGill University, was engaged for

three months of the past season in a detailed examination of the serpentine belt of the Eastern Townships of Quebec, with a view of ascertaining the mode of occurrence of the asbestus, chromic iron, talc, and other minerals. In view of the growing importance of this mining district it has been thought well to revise our present economic geology of the entire serpentine belt, and Mr. Dresser's work of the past season was undertaken with that object. He has covered during the present season the immediate vicinity of the principal mines of Thetford and Black lake.

Dr. R. CHALMERS was engaged in a detailed and critical examination of the surface deposits and glaciation of the St. Lawrence valley. The marine shore lines were levelled, and a number of new facts obtained in regard to Post-Tertiary changes of level.

Dr. R. W. ELLS was engaged in New Brunswick for the greater part of the season in tracing out the boundaries between the Upper Devonian and the Lower Carboniferous formations in the southern part of that province, and in an examination of certain Cambrian areas east of St. John. Several mining districts were also visited, and a trip was made to Prince Edward Island in connexion with proposed boring operations there for coal.

Dr. G. A. YOUNG spent the past season in an examination, as far as was possible, of the igneous areas of the Maritime provinces, with a view to their study. in detail, at a later date. He also visited the tin-bearing locality at New Ross, and is of opinion that more prospecting for this mineral should be undertaken throughout the granitic range of Nova Scotia.

Mr. E. R. FARIBAULT completed the topographical and geological surveys of the central part of Lunenburg county, N.S., extending along the Atlantic coast between Chester and Bridgewater. He worked out the detailed structure of the gold-bearing rocks of that region, including the veins operated at Blockhouse, as well as others which are still undeveloped. Extensive beds of gypsum and limestone, unknown until now, have been discovered underlying a thick covering of glacial drift. The deposit of tinstone and other rare and valuable minerals, recently discovered in the granites at New Ross, were examined, and samples were sent here for identification so as to assist as much as possible in the exploratory development of this promising new district.

Last season Mr. HUGH FLETCHER continued his surveys in Nova Scotia, chiefly in the counties of Kings and Annapolis, in the district lying south of the Annapolis valley and forming the part of the South mountain drained by the headwaters of La Have and Nictaux rivers, comprising sheets Nos. 97, 98 and 104.

Mr. Fletcher was assisted the whole season by Messrs. M. H. McLeod and Harold F. Tufts, B.A., and part of the time by W. W. Hughes, who were entrusted with the survey of the headwaters of La Have river, joining on to the south with Mr. Faribault's surveys made the previous summer, and extending west a short distance beyond the Halifax and Southwest Railway line. This region is entirely granite, and is covered with a fine growth of pine and spruce forest, owned for the most part by the Davison Lumbering Company, who have recently built a railway and extensive mills at Springfield, and who are probably doing the largest lumbering business in the province.

Adjoining the granite to the north are the iron deposits of Torbrook and Nictaux, which were fully examined, and the structure of the rocks was made out in detail.

Much of Mr. Fletcher's time was spent at Sydney, in resurveying the structure of the coal basin and tracing the outcrops of the more important seams, to give his evidence in connexion with the lawsuit last summer between the Dominion Coal Company and the Dominion Steel Company.

Mr. Fletcher also re-examined the Sir Wm. Logan's section along the shore at the Joggins, and has prepared a paper on the subject.

He also kept a record of the bore-holes being made at several places to prove the continuity and extension of the coal basins.

Up to the time of writing, Mr. Fletcher's report has not come to hand. Should it arrive in time, it will be printed at the end of this work.

7-8 EDWARD VII., A. 1908

# REPORT ON PORTIONS OF THE YUKON TERRITORY, CHIEFLY BETWEEN WHITEHORSE AND TANTALUS.

*D. D. Cairnes.*

This season was again spent in the Yukon territory, chiefly along the Lewes river between Whitehorse and Tantalus. I was again very ably assisted by Mr. H. Mathewson, who did a considerable portion of the topographical branch of the work.

The Yukon territory was reached about May 25, by the usual route via Vancouver and Skagway, and those properties were first visited which had been worked on Windy Arm during the winter. After arriving in Whitehorse and completing the necessary arrangements, we left that town on June 1 and proceeded by canoe down the Lewes river towards Tantalus, having to remain, however, at the upper end of Lake Laberge a few days to allow the remaining ice on the lake to thaw or shift sufficiently for us to get through with our canoe.

Owing to instructions received during the latter part of the season to collect statistical information for the Mines Branch, geological explorations were somewhat curtailed.

The double object of the expedition included further surveys of the coal seams examined last year, some samples of which coked successfully in the laboratory, and of the copper deposits of the Whitehorse district, where successful working is largely dependent on accessible coal suitable for producing a metallurgical coke.

Discoveries of coal were reported at a number of points along Lake Laberge, the Lewes river, and its tributaries the Teslin and Big Salmon rivers. These were examined, as well as the geological formations, generally, along the river to Tantalus.

Except within a few miles of Tantalus, where the Tantalus coal measures cross the river, this so-called coal proved in most cases to be dark or black shales, sometimes more or less bituminous; in other instances the seams of coal, where they did exist, were only a few inches in thickness and of no present economic importance.

## AREAS EXAMINED.

Along the river to Lake Laberge, on the lake shores and westward for a few miles, none of the known coal-bearing horizons were met and no coal was seen. The formations here have a general northeasterly and southeasterly trend and the Tantalus coal measures were believed to extend in a southerly direction from Tantalus and to lie to the west of Lake Laberge. A map sheet was therefore projected covering an area about ten miles wide in a north and south direction and extending to the west from Lower Laberge for a distance of about twenty-five miles. The coal measures lie just to the west of this map sheet, but for the reason above mentioned the map was not extended far enough to actually include them.

From Lake Laberge the geological work was continued along the river to Tantalus, after which the auriferous veins and placer deposits of Livingstone creek were examined, as also the reported coal outcrops up Salmon river.

Having arrived at Tantalus another map was commenced which was intended to include the Tantalus and Five Fingers mines and the coal measures in their vicinity. Having completed the work along the river, pack-horses were procured and the survey was continued to the south away from the river.

In addition to the above work quartz properties were examined in the vicinity of Dawson and on Williams creek which enters the Lewes river six miles below Yukon crossing.

## TOPOGRAPHY AND FLORA.

The Lewes river between Whitehorse and Tantalus flows in a wide valley having a general north and south trend, and is extremely tortuous in most places, particularly below Lake Laberge, which is a portion of the river that has acquired considerable width and possesses very little grade.

The district examined this season is a typical representative of an uplifted plateau of erosion and is a portion of the Yukon Plateau province. To the west and east, particularly toward the north of the district, there is an abrupt change from the plateau to the mountain provinces of the Coast range and Rocky Mountain range respectively.

To the west of the lower end of Lake Laberge, and about 1,000 feet higher, the valleys, which often contain chains of lakes, are characterized by muskegs. The hills, as a rule, are mostly covered with underbrush and small timber, chiefly spruce, aspen and poplar.

To the north there is a particularly long chain of lakes which is drained for the greater part by Mandanna creek, a stream about four miles long that joins the Lewes from the south, nearly opposite Eagle Nest. The most southerly of these lakes, Frank lake, is over five miles long and has an average width of a mile. One branch of this chain continues west towards Montague on the Dawson-Whitehorse wagon road; the other branch continues about fifteen miles in a direction about S.S.E. The valleys of this portion of the country generally contain lakes of considerable size, and the hills, which are well rounded, are covered with small spruce, poplar, willow, and shrubbery of different sorts. Rock outcrops are very scarce.

Continuing down the river towards Tantalus the hills on the north slopes are chiefly covered with spruce and Banksian pine. Patches of poplars and willow are occasionally seen. The south slopes along the river are more open, some being quite bare; the little timber seen is chiefly poplar and willow. The country farther back from the river here, and that just west of the river between Tantalus and Five Fingers, is practically all covered with spruce, Banksian pine, poplar, and willow, the greater part being spruce. The river flats generally support a growth of poplar, willow and a species of scrub alder.

## GEOLOGY.

From the upper end of Lake Laberge to Five Fingers the formations seen are similar to those in the more southerly portions of the Yukon. The oldest rocks exposed are Carboniferous limestones which belong in all probability to the Upper Câche Creek series. Above these are porphyrites, tuffs, tufaceous sandstones, shales, &c., corresponding to the Windy Arm and Tutshi series. Towards the north, however, the porphyrites, tuffs, &c., gradually give place to true sediments. Overlying these

latter rocks are the coal-bearing Jurasso-Cretaceous beds, which are buried under more recent sediments and Tertiary flows of lava, &c. Intrusive granites, syenite-porphyrites, and porphyry dikes also occur.

Along the east shore of Laberge the rocks belong chiefly to the limestone series, although some of the more recent rocks, similar to those on the west shore of the lake, are found overlying these unconformably. Along the west side of the lake the rocks, which are chiefly bedded and dip at high angles, are generally coloured tuffs and tufaceous sandstones. These are either finely-bedded or coarse greenish and massive. They are associated with dark, almost black, shaly rocks with occasional brownish bands. Heavy massive beds of very coarse conglomerate also occur, the contained boulders being often one to two feet in diameter. This whole series, lithologically, closely resembles the Tutshi series farther south.

South and east of Lower Laberge are some porpyhrites, porphyries, tuffs, &c., closely resembling the rocks of the Windy Arm series and cut by dikes of typical syenite-porphyry. To the west the outcrops largely consist of coarse, massive beds of conglomerate, from 600 to 700 feet thick, the component pebbles and boulders being chiefly porphyries and granite. Underlying these are thinly-bedded greenish and brownish sandstones and some dark coloured clays. This series is here seen to overlie the limestone series unconformably. Farther west, towards the Whitehorse-Dawson road, there are more tuffs and tufaceous sandstones and shales, generally quite massive, resembling those along the greater part of the west side of Lake Laberge. Outcrops are very scarce in this district.

From Lower Laberge to Hootalinqua the outcrops are chiefly limestone and rocks resembling the Tutshi series.

On the left of the Lewes river, just above Fife creek, conglomerates similar to those at the Tantalus coal mine occur for four or five miles. Though no coal was found here it will probably be discovered in the future. This was the only place at which this formation was noticed along the river until near Tantalus.

West of Salmon river an outcrop of the coast granite was seen, but the greater part of the outcrops here and along the Semenow range consists of generally greenish, fine-grained, and often quite calcareous porphyrites and tuffs. Below Salmon river these porphyrites, &c., continue to near Little Salmon, where true sediments commence. Below Little Salmon river to Tantalus practically all the exposures are limestones or other sedimentaries.

On the right limit of the Lewes river, below Little Salmon, the hills are conglomerate and sandstone to Eagle Nest, which is limestone. Just below, an almost perfect section of the sedimentaries occurring in this vicinity is to be seen unconformably overlying the limestone. Immediately above the limestones are the coarse massive sandstones like those causing the rapids at Five Fingers and elsewhere, and here called the Laberge conglomerate. Overlying these conformably is a series about 1,200 feet thick, which consists of dark shales and lighter coloured sandstones. The dark shale beds which are at times somewhat carbonaceous and contain small areas of lignite, comprise a considerable portion of this series. No lignite seams more than one to two inches in thickness were seen. In addition to these shales there are some thick beds of light grey, yellow and brownish sandstones, the light beds being soft, coarsely bedded and somewhat calcareous. They weather easily and are quite noticeable horizon markers. Some of the beds are more thinly bedded, harder and more siliceous. Remains of tree

trunks are of frequent occurrence, particularly in the lighter coloured strata. This whole formation, with the exception of the dark shale bands, presents a coarse-grained, light-coloured appearance. Above this is a reddish series, in the lower portions of which are some narrow seams of lignite on which some prospecting has been done near Eagle Nest. Wider seams may yet be found. These reddish sedimentaries, which are generally coarse-grained, often thinly-bedded and quite calcareous, decompose readily by weathering. A heavy conglomerate bed of the same material occurs near the top of the series here. Though at least 200 feet were observed, the uppermost series were not seen in this section.

These beds in this section outcrop continuously along the river bank to within ten or twelve miles of Tantalus. Their strike is roughly parallel with the river, and the dips being away from the river the outcrop of the different beds shows an apparently horizontal stratification.

Nearer Tantalus are outcrops of the conglomerate formation, or beds, in which the coal at the Tantalus mine occurs. These conglomerate beds are here at least 500 feet in thickness; the top strata in particular shows distinct bedding, the beds being generally two to ten feet thick and very similar in appearance and composition. Chert, black quartz and slate pebbles, apparently derived from the Câche Creek beds, are the chief components. These conglomerates, though not seen in contact with any other formations, are considered to be probably the oldest sediments in the district. Overlying them are some massive, quite coarse, and very light-coloured sandstone beds somewhat resembling the coal conglomerates, but derived, apparently, chiefly from the coast granites.

Extending for several miles along the left limit of the river below Tantalus are basalt, melaphyres, &c., which are very recent and are associated and interbedded with some of the later sediments around the Five Fingers mine and elsewhere. These lavas, &c., are the newest geological formation in this district, except the glacial and post-glacial silts, boulder-clays, &c.

## ECONOMICS.

In addition to the districts mapped this season, properties were examined in the following localities: Windy Arm, Livingstone creek, Dawson and Williams creek.

## WINDY ARM.

The only properties that have been working on Windy Arm, to any extent, since last season, are the Vault, Venus, and some of those controlled by the Anglo-American Consolidated Mining Company.

Owing to internal dissensions and other causes, the development of the properties on Windy Arm has been much retarded. In most cases the promising properties have continued to improve with development.

Owing to difficulties arising between the owners and the Anglo-American Consolidated Mining Company, work has been curtailed on the claims bounded by the latter.

On the Vault, which has been worked continuously for over two years, a long tunnel is being driven, but the ore had not yet been tapped when the mine was visited about October 1.

On the Venus, approximately 1,800 feet of work has been done this season, with the most promising results. A considerable quantity of ore is blocked out, and one

hundred tons shipped to the Tacoma smelter this fall netted over $60 per ton after all smelting charges and deductions were made. The ore is a concentrating one and it is the reported intention of the company to erect a mill on the ground in the near future.

### LIVINGSTONE CREEK.

A description of the geology and topography of Livingstone creek is given in Mr. R. G. McConnell's report and map on the 'Big Salmon Gold Fields,' in the Summary report of the Geological Survey for 1901. Since that time the old creek channel has been discovered and is being worked.

The gold is, or was, chiefly in this pre-glacial channel. Since glacial times the present creek has been cutting farther and farther into the thawed south bank, the gravels on the north bank being frozen, so that now, above the canyon near the mouth of the creek, the old channel is on the left limit of the present creek valley. Near Discovery the two channels apparently coincide, and, the present creek having the greater grade has worn down the older channel, into which it has concentrated its values. Above Discovery the gold is practically all in the old channel and is recovered by tunnelling from the present creek bed through the rock rim to the old channel and drifting on it. The pay on the old channel averages about thirty feet in width and two feet in depth, although it is considerably wider in places. There is quite enough grade to the creek for sluicing. The hillside claims, i.e., those on the old channel gravels, have produced, on an average, about $25,000 each.

About $90,000 was taken out of this creek last season and there will probably be over $100,000 taken out this season (1907).

Similar conditions exist on the parallel creeks, Summit lake, Coltoneva and Little Velvet, but owing to scarcity of water only a small amount of work has been done on them. What has been done has given very encouraging results and it will probably pay to bring water from Mendocina creek or elsewhere.

### TANTALUS MINE.

Since reporting on this property last season considerable progress has been made. The two main tunnels had, by August 1, 1907, been driven in over 1,800 feet, and twenty-three rooms had been opened up on No. 2 and eight on No. 1 seam.

Five thousand, one hundred and seventy-three and a half tons of coal were shipped last summer, and it is expected that about 9,000 tons will be shipped this summer.

### TANTALUS COAL MEASURES.

At Tantalus mine the formations dip to the east and on Tantalus butte, across the river, they dip to the west, showing the presence of a synclinal fold. The continuation of the eastern wing of this fold was noticed about a mile to the east of Tantalus on the left bank of the river. On account of heavy wash the coal is here not exposed, but a small amount of stripping should uncover the seams.

These measures, which cross the river at Tantalus, are known to extend in a northerly direction for several miles at least and in a southerly direction over fifty miles, crossing the Whitehorse-Dawson wagon road seventy miles from Whitehorse. In all probability they extend considerably farther. Throughout a distance of sixty miles they have been traced and wherever a section has been made two or more work-

able seams of good bituminous coal have been found. In the only places from which it has been obtained at a depth the coal cokes quite satisfactorily.

### TANTALUS BUTTE.

At Tantalus butte and just across the river from Tantalus, only assessment work has been done. A section was examined this season and the following seams were measured and sampled:—

| | | Feet. | Inches. |
|---|---|---|---|
| No. 1 | Coal | 0 | 7 |
| | Shale | 0 | 3 |
| | Coal | 6 | 1 |
| | Shale | 0 | 6 |
| | Coal | 0 | 10 |
| No. 2 | Coal | 9 | 10 |
| No. 3 | Coal | 8 | 10 |

Three smaller seams, fourteen feet, ten inches and six inches, respectively, were also measured.

All this coal is bituminous and of about the same quality as at Tantalus; when clean it yields a firm, coherent, coke, i.e., if obtained at a sufficient distance from the surface to be free from weathering.

### WILLIAMS CREEK.

A number of claims have been staked this season on and near Williams creek. The Bonanza King, which was about the first staked and which was the only one on which any work had been performed, was visited in August. It is situated about one and a-half miles up Williams creek, a stream flowing into the Lewes river about six miles below Yukon crossing.

The ore is quartz, carrying chiefly the copper minerals bornite, chalcopyrite, and malachite. The vein is about six feet wide from wall to wall, including, in this thickness, one to two feet of the country rock. The ore is in a fissure, or fissures, in granite, near its contact with older, much altered diabase, now quite schistose in structure.

When seen, a shaft had been sunk about twenty feet on the ore and a tunnel had been driven about forty feet to cut the vein.

The ore is claimed to carry values in gold, silver and copper; however, average samples obtained by the writer gave only traces of gold and silver and 3·29 to 4·21 per cent copper.

### CONCLUSION.

The chief result of this season's geological work has been the locating of enormous quantities of available bituminous coal in this portion of the Yukon territory. Full particulars, accompanied by contoured geological and topographical maps, will be published in the writer's detailed report.

7-8 EDWARD VII., A. 1908

# REPORT ON THAT PORTION OF THE COAST OF BRITISH COLUMBIA, EXTENDING FROM POWELL RIVER TO KINGCOME INLET, INCLUDING THE ADJACENT ISLANDS.

*J. Austen Bancroft.*

The work outlined in the following report is a continuation of that which was carried on by Mr. O. E. LeRoy during the summer of 1906. A week less than three months was spent this summer in actual field operations on the coast by the writer, who had with him a most efficient assistant in Mr. R. P. D. Graham, Demonstrator in Mineralogy at McGill University. That portion of the coast extending from the mouth of Powell river to the entrance of Kingcome inlet was covered, an examination being also made of the islands, within this stretch, between Vancouver island and the mainland.

The general trend of the coast is here N. 52° W., corresponding to a line drawn between these points, and along such a line the distance traversed was 112 miles. An idea can, however, be gained of the irregular nature of this coast by the statement that 1,540 miles of coast were examined, 680 of this being mainland and the remainder representing the extent of shore line presented by the numerous islands. This is as fine an example as exists in the world of a deeply dissected land area which has been submerged. Vancouver island once was connected with the continent, and in the intermediate lowland there then existed at least one or two river systems, receiving tributaries chiefly from the east. Submergence drowned the river valleys, thus accounting for the salt water straits and inlets of to-day, while the many rugged islands represent former inter-stream areas.

During Triassic, and probably late Palæozoic, times this region formed a portion of the ocean floor, and sedimentation was taking place. The latter part of the Triassic was marked by intense volcanic action, probably subaqueous in origin. This history is expressed in the isolated area of argillites, quartzites, and limestones, and the many varieties of volcanic rocks, such as amygdaloidal diabase, porphyrites, agglomerates, and tufas.

During Upper Jurassic times these stratified rocks, which once covered the region, were intruded in a widespread manner by granite and allied rocks. This vast intrusion, known as the Coast Range batholith, is largely composed of granite, but over wide areas it passes into basic facies which are most interesting. Diorites and gabbros are very common, while in Bute and Knight inlets it exists over quite large areas as almost pure hornblende. On a few small islands to the west of Midsummer, and north of Fire island, there is a beautiful development of an orbicular or kugel diorite.

The stratified rocks, then, formed the roof of this batholith. During the intrusion of the latter, portions of the roof were stoped off and engulfed within the magma; others, partially attached to the roof, draped themselves into it as 'roof pendants,' while, in other places, the stratified rocks may have been actually folded into the

magma. Especially up the deeper inlets, that is, towards the axis of the Coast range, the granite is locally gneissoid, and a schistose structure has been developed in some of the areas of stratified rocks. The strike of such gneissoid and schistose structures corresponds in general with the axial direction of the range. Two sets of dark dikes have cut the region since the cooling down of the batholith.

To-day, erosion has removed the roof, with the exception of a few isolated patches, and has truncated the included stratified masses. It is exceedingly important that these scattered areas of stratified rocks be located and mapped, for it is within them, and especially along their contact with the intrusive batholith, that the prospector should look for minerals of economic value. Within the region examined about fifty areas of such rocks were located.

Though only one fossil specimen had hitherto been found within the whole of this area, we were fortunate enough to discover five localities that contained among them at least four species.

About thirty-five prospects were visited during the course of the summer. South Valdez island was the only locality where mining operations were being carried on in the district at the time of visitation. From Kelly point to Quathiasca cove this island is underlaid by volcanic rocks. These represent a portion of one of the roof remnants of the batholith. Once floating on the plastic magma, during the adjustment upon cooling down, small faults formed in these volcanics. Heated waters and vapours passing up the fault and joint-planes deposited copper minerals along these cracks, and where the adjacent rock was very porous, because of its amygdaloidal character, it became impregnated, chiefly with chalcocite, and with less quantities of bornite and native copper. This accounts for the stringers of chalcocite along a zone of shearing in the Ajax claim, situated on the north of Deepwater bay (at an altitude of 950 feet above sea-level and about one mile from the shore), and for the irregular vein on 'The Ingersoll,' situated about two miles from Copper Cliff. On 'The Ingersoll' a very irregular vein of chalcocite with a gangue of calcite and quartz may be traced for 350 feet with a maximum width of fifteen inches, the country rock being unevenly impregnated for a width of thirty-four feet. The Copper Cliff, Commodore, and Steep Island mining properties are situated on highly amygdaloidal beds through which are disseminated over wide areas, chalcocite, a little native copper, and, on the Commodore, some bornite.

From Open bay, on the east of South Valdez island, to within a mile and a half of Granite bay on the west side, there extends a series of limestones and interbedded greenstones having a maximum width of a little over a mile. In this area, which deserves the most careful prospecting, a number of claims have been located. On the 'Lucky Jim,' along a contact between the limestone and a greenstone layer, chalcopyrite, pyrrhotite, pyrite, and some magnetite have been deposited. On 'The Geiler,' a shaft twenty feet deep sunk on a similar contact, displays a very good showing of chalcopyrite. A speck of free gold was noticed in a specimen taken from "The Geiler.' This area is, of course, not yet sufficiently examined to properly determine its possibilities, for at no point has it been opened up to a greater depth than twenty-five feet.

On the north of Rodonda island the Elsie claim is staked on a deposit of magnetite that occurs at a contact between the granite and a patch of marble. At an

altitude of 500 feet, one open cut has exposed fifty-four feet of magnetite, with a width of thirty-five feet, and at two other points smaller amounts have been uncovered. This property should be tested in depth for the ore is high grade and shipping facilities, although the ascent from the water is steep, could be quite easily arranged.

The Shoal Bay area, which is now deserted, is associated with contact phenomena between the granite and stratified series.

On Mars island, to the southwest of Baker island, small quantities of bornite and galena were found in a limited area of argillites and limestones. On one of the joint planes of a quartzite layer flecks of leaf gold were seen.

On the northwest of Village island, in another area of argillites, a small amount of chalcopyrite and bornite was noticed.

Granite, suitable for building stone, may be found at a number of different localities with excellent opportunity for immediate shipment by water. At Squirrel cove, Walsh cove, towards the head of Pendrell sound, and at Kwatsi bay, the granite affords such commercial possibilities. The area of orbicular diorite above mentioned would furnish a unique and very beautiful ornamental stone.

In certain depressions on South Valdez island, Manrelle island, and especially Reade island, the finer grained glacial clays should make excellent material for the manufacture of bricks.

An examination was also made of a hematite deposit, owned by Mr. Stuart Henderson, M.P., of Ashcroft, a detailed report of which will be rendered shortly.

# THE BULKLEY VALLEY, B. C.

*W. W. Leach.*

According to instructions work was continued in the Bulkley valley and vicinity during the past season. The topographical map, compiled last year, and now in the engraver's hands, was used as a base, being extended both to the north and south, but chiefly to the north, including the Bulkley valley as far as Moricetown, the Hudson Bay mountains and the headwaters of the Zymoetz (Copper) river, as well as some work done on the head of Paint creek and the Morice river.

A carefully made transit and chain traverse was run from the town of Telkwa to Moricetown as a check on the triangulation of last year.

The season, on the whole, was unfavourable for topographical work, a late wet spring being followed by an exceptionally dry, hot summer, with, as the result, many forest fires and a dense smoky atmosphere during the short season in which work is possible in the higher mountains.

The greater part of the season was spent in the upper part of the Telkwa river and the country lying between that river and the Zymoetz; this district has been very little prospected and the absence of trails made progress slow.

## TOPOGRAPHY.

The Telkwa, above the south fork, occupies a wide, flat valley, the river meandering through swampy meadows; its course here is approximately northeast and southwest. About twelve miles from the south fork, near Mill creek, the valley turns sharply to the south and at the bend an unexpected and low pass leads off to the west to Summit creek, a branch of the Zymoetz; this pass may be of great importance, for it has been occupied by one of the several surveyed lines of the Grand Trunk Pacific.

Milk creek rises in a high and rugged range of mountains forming the divide between the Zymoetz and the Telkwa rivers; this range rapidly decreases in height to the eastward, forming a plateau-like country, where the highest point reaches an elevation of only 6,600 feet, finally dropping down to a low pass, in which Pass creek rises, and which separates it from the Hudson Bay mountains.

The last named range though quite rugged, the highest points reaching at least 8,000 feet, is cut off on all sides by low country and, therefore, forms a very conspicuous feature of the district.

In most cases the headwaters of the Zymoetz occupy wide, flat valleys interspersd with many small lakes and much meadow land.

The country, as a whole, with the exception of the Coast range, is characterized by a series of isolated groups of mountains surrounded by low valleys in which the river and creek systems have little regularity.

GEOLOGY.

By far the greater part of the country traversed is underlain, as described in last year's report, by rocks of the Porphyrite group, mainly composed of andesites, tuffs, and agglomerates and almost entirely of volcanic origin.

From the head of Milk creek westward the rocks, which are all of the Coast crystalline series, have not been studied in detail, no minerals of economic importance having yet been discovered in them.

The most important rocks, from the miner's point of view, are those which have been called 'the later eruptives,' as all the important mineral discoveries of the district are situated in the volcanics near their contact with these rocks or in or alongside dikes from their main bodies. These eruptives have also had an important influence on the quality of the coal. They constitute the youngest rocks of the country, cutting both the volcanics and the coal formation, and are found usually either as a pinkish syenite porphyry, or as a light greyish granite porphyry, the dikes from them varying greatly in appearance.

Two important areas, one on Scallon creek, the other at the head of Glacier creek, were referred to last year. Another small area was noted on the ridge between Morice river and Goldstream, and yet another near the head of the north fork of the Telkwa; little or no prospecting has been done in the neighbourhood of either. A large area of these eruptives was found on the western ridges of the Hudson Bay mountains. This locality has received much attention of late and many mineral claims have been located.

MINERAL CLAIMS.

Immediately on arriving at Telkwa (at the mouth of the Telkwa river) a short trip was made to Hankin's camp, situated at the head of Goat creek, where a group of claims have been located by Messrs. Loring, Forrest and the Hankin Brothers. These are among the oldest mineral locations in the district, and a good deal of prospecting, consisting of open cuts and several short tunnels, has been done on them.

The country rock consists of typical beds of volcanics, tuffs, agglomerates, andesites, &c., belonging to the Porphyrite group and here lying nearly horizontal and well exposed at many places on both sides of the rather deep, narrow valley. These beds are cut by a number of roughly parallel, light-coloured quartzose dikes with a nearly vertical dip and crossing the valley approximately at right angles.

The mineral deposits occur in nearly horizontal beds following the bedding planes of the volcanics and show decided enrichment in the immediate vicinity of the dikes; the mineral bearing solutions have apparently ascended along the walls of the dikes and thence, following the bedding planes, have decomposed the more readily attacked volcanic beds.

On the 'Eldorado,' 'Naiad' and 'Telkwa' claims the best showings of mineral are to be met with; here at least two beds of ore, each about five feet in thickness, may be seen, consisting of iron pyrites, copper pyrites, a little pyrrhotite, and magnetite, in a gangue of altered country rock, epidote, quartz &c. The percentage of copper is small, but, according to the owners, fair values in gold are to be found. The ore bodies are very much thicker in places, more particularly immediately alongside of the dikes.

Many of the claims on Howson creek were described in last year's Summary, but

this locality was again visited this year, considerable development work having been done and various new claims located.

At the 'Evening' claim a cross-cut has been run for seventy feet in low grade ore, the main body, exposed by cuts on surface, not having been yet reached.

On the 'Duchess' a tunnel has been driven for sixty feet, starting at a very good exposure of copper ore and following the foot-wall of the ore-bearing dike. The ore is continuous for the length of the tunnel. Several open-cuts have been made up the hill on what is supposed to be the 'Duchess' dike; one of these shows six feet of good ore, the others very little, but the dike is much decomposed and iron-stained.

There are a number of parallel dikes here, some of them ore-bearing, which have a general north and south strike, about at right angles to the direction of the valley. As the ground is mostly drift-covered, and the dikes are often quite close to one another, it is a difficult problem to ascertain, for any distance, which dike one is following.

The 'Countess' claim, owned by the same company as is the 'Duchess' (The Telkwa Mines, Limited), is situated near the top of the ridge on what is probably a similar and parallel dike. An open cut has been made here, but not much ore is in sight; a small cut, however, on the same dike at the top of the ridge has a much better appearance, the ore there being similar to that at the 'Duchess.'

Across the ridge, to the north, in a small basin in which rises a branch of Howson creek, a number of claims have been staked. Among these the 'Standard,' 'Princess' and 'Contention' are also owned by the Telkwa Mines, Limited; on only one of these, the 'Standard,' was any work seen. It consisted of a small open cut showing from eighteen to twenty inches of good ore, composed of chalcopyrite and specular iron with a little quartz. The ore occurs in a dike along the hanging wall.

In this basin, as at the 'Evening' and 'Duchess,' a number of parallel dikes occur, with approximate north and south strikes and cutting the bedded volcanics; the ore is found in the dikes, usually near the walls, and at times extends into the country rock.

The Telkwa Mining, Milling and Development Company have also a number of claims here, among others the 'Whispering Wind' and 'Silver Heels.' On the latter a large dike from fifty to sixty feet wide exists, striking north and south and dipping 75 to 80 degrees east; on the easterly or hanging wall about four feet of chalcopyrite and specular iron ore was seen, but no work has been done; on the westerly wall, however, a large open cut shows fifteen feet of good ore consisting of chalcopyrite, specular iron, and a little iron pyrites with a gangue of quartz and altered country rock.

On the south side of Howson creek a number of claims owned by the Telkwa Mining, Milling and Development Company were visited, the most important being the 'Walter,' 'Iron Colt,' 'Granville,' 'Strathcona' and 'Anna-Eva.' All of these were seen last year, and little has been done since. The ore occurs in dikes from the large porphyry area on Scallon creek cutting the rocks of the Porphyrite group, and is generally much decomposed. A sample of black, earthy material from the 'Strathcona' was found to consist of oxides of copper, manganese and iron.

Most work has been done on the 'Anna-Eva,' an open cut over 150 feet in length having been made across the face of the dike. The mineralization is irregular and not very heavy, and the whole dike is much decomposed, the ore consisting of copper

carbonates, chalcopyrite, iron pyrites and specular iron. A short distance to the south, on top of the hill, where the ground is heavily drift-covered, a new cut had been started, showing much higher grade ore, chiefly chalcopyrite and specular iron with a good deal of quartz, across a width of about twenty-five feet.

The Hudson Bay mountains were visited late in the summer, but as all the prospectors had left for the season, it was almost impossible to find where the chief claims were situated. However, a few were seen.

At the head of Lyons creek, on the eastern slope of the range, two claims, the 'Copper Queen' and 'Iron Mask' are near the edge of a small granite area cutting the volcanics, and the mineralization appears to follow the bedding of the decomposed andesites. The ore consists almost entirely of arsenical pyrites in a quartzose gangue, but not enough work has been done to show the extent of the deposit. A specimen of this ore gave by assay: gold, $8; silver, 0·52 ozs. to the ton.

About one mile down Lyons creek, on the south side, some work had been done, but the name of the claim could not be ascertained. The ore occurs in a large dike, about seventy-five feet wide, near the hanging wall, and shows about three feet of fairly well mineralized material consisting of arsenical pyrites, some copper carbonates and a very rusty quartz in bands parallel to the dike wall.

On the western slope of the mountains, near the head of a small stream running into the Zymoetz river, the 'Tower Hill' claim is situated. The country rock here, consisting chiefly of red and greenish andesites, has been tremendously disturbed, and some splendid samples of folding on a large scale may be seen. A number of open cuts have been made in what appears to be a thin bed of greenish andesite, much altered and containing some copper carbonates, a very little bornite, some quartz, calcite, epidote, &c.

There are said to be other and better showings in this neighbourhood, but the writer was unable to find them.

## COAL.

During the past year practically nothing has been done on the coal properties of the Kitimat Development Syndicate, the Cassiar Coal Company or the Transcontinental Exploration Syndicate, all situated on the Telkwa river or on Goat creek, one of its tributaries. Until the route of the Grand Trunk Pacific railway is finally decided on it is not probable that much development will be undertaken.

On the property of the Telkwa Mining, Milling and Development Company, located on Coal creek, at the headwaters of the Morice river, a little exploration work has been carried on, and the limits of this are fairly closely defined. Although the area is small the coal is of very high grade, as the following analyses show:—

| All Non-Coking. | Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|---|
| 1.—5 ft. 6 in. seam | 1·36 | 10·87 | 80·82 | 6·95 |
| 2.—7 ft. 3 in. seam | 0·80 | 11·10 | 78·90 | 9·20 |
| 3.—4 ft. 0 in. seam | 0·58 | 10·80 | 82·70 | 5·90 |

The anthracitic quality of this coal may be explained by its contiguity to two areas of later eruptive rocks, one at the head of Glacier creek and the other on the north side of Goldstream, and to the great heat and pressure consequent on their intrusion.

On Goldstream, a little below its junction with Coal creek, and separated from the above area by a short distance only, a new coal area was discovered this year. This area, about two by two miles and one-half, at its greatest diameters, is in the form of a basin, the coal outcropping on both sides of, and from 400 to 500 feet above the floor of, the valley. The coal dips towards the creek from both sides with a slope rather greater than that of the hills, so that it underlies the bed of the stream, although at no great depth.

Up Goldstream this area is separated from that on Coal creek—probably by an anticline, the coal measures having been removed from its axis by denudation. At the lower end the limits of the coal-bearing strata are not so clearly defined, but, in all probability, the creek has there cut through the coal measures to the underlying volcanics, this cutting being accentuated by another anticlinal fold.

The coal has been opened up at only one place, where two seams have been uncovered, the upper one showing five and one-half feet of clean coal overlain by about one and one-half feet of soft impure coaly material, the cut not having been extended far enough to locate the roof clearly. The lower seam shows three and one-half feet of clean bright coal. No analyses have as yet been made of these coals, but in appearance they closely resemble the coal from Coal creek, analyses of which have been given above. At several other points across the basin the coal outcrop was noted, but no time was available to open up the seams.

No evidences of local disturbances or faulting of any great extent were noted.

Another and smaller area was seen about two miles farther down Goldstream, but has not been opened up.

Other areas of the coal-bearing rocks were noted at Driftwood creek, Moricetown, at the head of the Zymoetz river, and on Hudson Bay mountain, but at none of these localities has any workable seam been yet found, and it seems probable that the seams reach their maximum thickness in the Telkwa-Morice River district, and thin out rapidly, at least towards the north.

It is now fairly certain that no great coal field exists in the Bulkley Valley district from Hazelton to the headwaters of the Morice, but many comparatively small, isolated areas are known in which the coal varies from a lignitic to a semi-anthracite. In some of these areas the strata are greatly disturbed, much faulting and folding being in evidence.

The quality of the coal seems to depend on the proximity of the measures to the newer eruptive rocks which are younger than the coal, and in places have sent out dikes cutting the seams.

A number of fossils were collected from the coal measures and adjacent beds; although none of these have as yet been determined, there is sufficient evidence to state that these rocks are probably Lower Cretaceous, though possibly Jurassic.

# CAMP HEDLEY, OSOYOOS MINING DIVISION, B.C.

*Charles Camsell.*

The important mining camp of Hedley is situated on the north side of the Similkameen river, at the mouth of Twenty-mile creek, in the Osoyoos mining division of British Columbia. It comprises about 100 surveyed and Crown-granted mineral claims, and many others on which the annual assessment work is still being done, all covering a sheet of about twelve square miles. It was discovered in the year 1896, when nine claims were staked on the ground overlooking Twenty-mile creek. Each succeeding year found more and more prospectors impressed with the possibilites of the camp, and more claims were taken up, until in 1900 virtually all the ground now included in Camp Hedley was staked out. The largest property owners in the camp, the Yale Mining Company, were early on the ground and commenced the work of prospecting their most important claims early in 1899. The preliminary work undoubtedly proved satisfactory for they shortly after showed their faith in their prospects by beginning the building of a tram line, flume and stamp and cyanide mill, a work entailing the outlay of hundreds of thousands of dollars. Though it is a little more than three years from the time the first ton was milled, and the ore is extracted from only two claims, the camp has since justified their faith in it by becoming the largest producer of gold alone of any camp in British Columbia. It is very probable as development goes on and transportation difficulties are overcome new ore bodies will be discovered and other known ore bodies of lower grade will be worked, for the history of mining is only now beginning in this portion of the Similkameen district.

As the only previous work done in this neighbourhood was the reconnaissance of Dr. Dawson in 1877, when there was not the slightest suspicion of such valuable ore occurring, it will be readily seen how urgent was the need of the work of a Geological Survey party.

The field work of the season was in part devoted to the acquiring of data for a topographic map of the camp, which will cover, when completed, three miles from east to west, and four miles from north to south. The scale on which this is being prepared is 1,000 feet to the inch, with a contour interval of 100 feet. Geological studies were carried on at the same time in conjunction with the topographic work, and special attention was paid to the occurrence of the ore deposits, their origin and history; but the attempt to do both simultaneously and with the same party was responsible for neither being finished at the close of the season. Much credit is due for their zeal and co-operation to my two assistants, Messrs. J. A. Allan and A. O. Hayes, who, besides assisting in the geological work are to be credited with a great deal of the topography.

The method employed in mapping the district was that suggested by Mr. W. H. Boyd as likely to give the greatest accuracy for the time and means at hand. Triangulation on signals from an accurately measured base gave a number of fixed points on the sheet. Traverses were run with transit and stadia of all the wagon roads in the district, as well as most of the trails, the tram lines and flume; and the detail was filled in

with the plane table and stadia-readings. Elevations were obtained from a Canadian Pacific Railway bench mark corrected to sea level. This gave the town of Hedley as 1,620 feet, and the highest point in the sheet as 6,660 feet above sea level. The unfinished portion, which covers the northwest quarter of the sheet, is much too rough and steep to be done in this way, and will have to be done by photographic surveying.

The work was also considerably facilitated by the interest taken in it by many of the people of the district. The Daly Reduction Company, through their manager, Mr. Ross, placed every convenience in our way, and the use of the gravity tram saved much time and hard labour. And of those to whom I am particularly indebted for information I may mention Messrs. F. M. Wells, C. E. Oliver, J. Gladden, A. Megraw; as well as the officials of the Yale Mining Company and the Daly Reduction Company.

## TOPOGRAPHIC FEATURES.

Camp Hedley lies on the western side of the Okanagan range of mountains, whose highest points here reach an elevation of a little more than 7,000 feet above sea level. The neighbouring country is characterized by comparatively rounded outline and moderate relief to the east and south, but the northwestern portion lies in the deep and narrow canyon of Twenty-mile creek, where extremely rugged and precipitous conditions prevail. The part of the valley of this creek which lies in our map is V-shaped, and about 4,000 feet in depth. The slopes on either side are very steep, and frequently impossible to climb. Broken rock talus slopes topped by precipitous bluffs are everywhere very common, while the narrow box-canyons cut by the torrential streams in the mountain side are nothing more than mere gashes almost imperceptible from the opposite side of the valley. These canyons are frequently the only possible means of ascending or descending the mountain side ,while the ridges between them are quite impossible to explore.

The action of erosion in this canyon is very strong, and is equal, if not in advance of, the decomposition of the rocks by oxidation, and the finding of secondary surface deposits of oxidized ores is not to be expected where such conditions prevail. Every shower of rain throughout the summer washes down the canyon sides masses of rock that only a little undermining was sufficient to dislodge, so that the Daily Reduction Company, whose flume runs for three miles through the canyon, have to keep men on the watch night and day to guard against or repair accidents from falling rocks. Drift does not cover the rocks in this section, so that in its accessible parts the geological relations are easily studied.

On the slope of Eighteen-mile creek and overlooking the Similkameen river the physical features are not so bold, and the conditions are not unlike those which hold over the rest of the Interior Plateau. This part is not heavily wooded and the southern faces are usually devoid of all timber. The slopes are not so steep that drift will not rest, and unless exposed by the pick and shovel of the prospector outcrops of rock are rare. The prospector who owns claims on this side of the hill is likely to incur a great deal more expense in prospecting, and he is also more likely when he does locate an ore body to find it very much more oxidized and enriched on the surface than in the Twenty-mile canyon.

For the diversity of physicial conditions on the two sides of the hill, one must look to glacial causes. Looking at the valley of the Similkameen river from the top of the gravity tram line, and particularly to the southward, one is at once

struck by its glacial outlines. The steep sides and broad drift-filled bottom make a well-defined U-shape that is characteristic of all valleys modified by the scouring action of a glacier. Typical also are the many hanging valleys that may be noted on the south side. Henry creek, Susanne creek and John creek all steepen suddenly in grade on approaching the main valley, and have not yet had time since the disappearance of the glacier to carve out a valley of uniform grade. The deep canyon of Twenty-mile creek may be also attributable to the same cause. The retreating glacier which filled the Similkameen valley eventually left the Twenty-mile creek occupying a hanging valley and emptying into the main valley by a short steep fall at its mouth. While the smaller streams were unable in the time since the disappearance of the glacier to cut down their valleys, Twenty-mile creek, with its larger volume and greater erosive power, was able to deepen its own bed in the rock and to form its present V-shaped valley. In this work it may have been materially assisted by taking advantage of the numerous faults and fractures that are found in these rocks, and which are the results of many and long-continued periods of vulcanism. The only other way to account for this Twenty-mile canyon is by a recent uplift of this portion of the earth's crust, of which there is not any corroborative evidence to be found in the surrounding country.

The whole Camp Hedley area was covered by ice during the glacial period. Though glacial striae were never noted, boulders transported by glacial action are found scattered over the summits of its highest hills.

## GENERAL GEOLOGY.

The geological history of the area is somewhat complicated, and while the general sequence of events has been roughly worked out, there are yet many details which will require more study both in the field and in the office.

From the time its first sediments were laid down in the sea, the region has been the scene of much volcanic activity. Igneous rocks of different kinds have been instrumental in altering the older rocks, so that now it often is impossible to state definitely whether some of these older rocks were originally igneous or sedimentary.

The oldest rocks are the sedimentaries that cover the greater proportion of the surface. They all belong to one series, and have been referred to the Câche Creek group of Dawson's classification. No determinable fossils have yet been found in them, but the lithological characters of the strata are very similar to the original Câche Creek rocks first described farther to the north.

These sediments are of great thickness, and as their prevailing dip is towards the west, a section from east to west across the sheet would give the succession in ascending order. This east and west section shows the following:— (1) red, grey and some black argillaceous and siliceous beds interstratified in thin bands; (2) blue and white limestone, much altered and crystalline, with some siliceous beds and breccia; (3) argillaceous and siliceous beds on the west side of Twenty-mile creek and extending some distance beyond the limits of the sheet. Interbedded with these are a great number of sheets of andesite highly mineralized with arsenopyrite and weathering to a reddish colour that gives to the sides of the mountain the beautifully banded appearance which evoked the name of Striped mountain from Dr. Dawson.

All of these beds have been more or less altered by igneous intrusions, but those which have suffered most are the calcareous ones of the middle division. This

division has also proved the most congenial for the formation of ore deposits, for in it lie the two producing claims on the hill, the Nickel Plate and the Sunnyside. The beds in which the ore bodies of these two claims occur have probably been originally limestone beds which become more or less impure towards the top, and near the contact of the igneous rocks have been altered by the addition of more silica to a rock made up largely of epidote and garnet with quartz and calcite. In other parts the alteration has been to pyroxene, or again to actinolite, but always with more or less garnet, epidote and calcite, depending upon the purity of the original beds. Irregular bodies of cherty rock are also frequently found in the contact metamorphic zone. About the centre of the sheet, in the P.S. draw, the alteration of the sediments has been to a rock made up almost entirely of garnets and which is called garnetite. In portions of the Nickel Plate mine the metamorphosed rock has a distinctly banded appearance due to the alternations of epidote and garnet in thin layers. Arsenopyrite is always a constituent of the contact metamorphic zone except where the igneous rock is granite. The monzonite and all its offshoots contain this mineral, and from them it migrated to the sediments.

The sediments on the eastern edge of the sheet are nearly horizontal. At the Nickel Plate mine they dip about 20 degrees to the west, but gradually steepen on the west side of the hill to 35 and 40 degrees. Across Twenty-mile creek and westward the angle of dip increases until it reaches 90 degrees, and the strata become closely folded and compressed.

Some volcanic activity probably took place while the rocks were yet beneath the sea which would account for the interstratified beds of breccia and of possible tuffs. Numbers of andesite sheets were injected before the sediments were folded as they now are, while other dikes of the same material could only have been injected after the folding took place.

The rock next in age to the sediments is a mass of monzonite forming a core nearly in the centre of the camp, and extending to the west side of Twenty-mile creek. The normal phase of this rock is rather basic in composition, and is made up of orthoclase and plagioclase in about equal proportions, much hornblende and some augite, biotite and quartz. A more acid rock, containing none or few of the dark coloured constituents, lies to the east of this and forms the very prominent Climax bluff. Each of these rocks sends off innumerable dikes and sheets of so-called andesite into the surrounding sedimentary rocks. The relation of these two rocks to each other is puzzling. Well marked contacts between the two are sometimes found, and these invariably show the acid rock to be the more recent. Apophyses of the more acid rock are also found in the basic. On the other hand, gradual transitions from the one to the other are frequently seen, and wide areas occur which appear to be intermediate in composition between the two extremes. Altogether it is probable that the two varieties were derived from the same magma, though their formation of crystallization may not have been contemporaneous. If not contemporaneous then the acid variety is later in age than the basic. The coarseness and evenness of the texture show their plutonic origin and that their crystallization took place far below the surface.

The dikes and sheets derived from this monzonitic core are also of two varieties, and show much the same composition as the mass, but with the development of a por-

phyritic structure. The acid variety appears to be more often connected with ore deposits than the basic.

Later than the monzonite is a large batholithic mass of granite, which forms the base of the hill overlooking the Similkameen river, and extends eastwards across Eighteen-mile creek. This granite is similar to the large area of granite through which the river cuts for fifteen miles between Hedley and Princeton, and is probably part of the same intrusion, though separate for a short distance from it. It holds both orthoclase and plagioclase, with quartz, hornblende and biotite. A dike-like mass as an offshoot from this, 100 to 400 feet wide, is connected with the main mass on Eighteen-mile creek and runs diagonally across the hill to a point on Twenty-mile creek one mile above the town. The composition of this dike is slightly different in that the hornblende is almost entirely replaced by biotite. Overlooking the Similkameen river the granite is in contact with the older sedimentary rocks, and this contact shows the granite truncating at an angle of about 30 degrees the edges of the sedimentary strata as well as the andesite sheets that are interbedded with them. The granite-monzonite contact on the Kingston draw shows many inclusions of monzonite in the granite, as well as apophyses of the granite in the monzonite.

Quartz porphyry and aplite dikes that cut both the granite and the sediments in several places are probably to be referred to the final stages of the granite intrusion.

A number of dikes of different composition follow the granite intrusion. Of these the most important are black and fine-grained, and are found in the northern and eastern parts of the sheet. They appear to radiate from a common centre near the foot of Bradshaw canyon. The texture of these dikes is felsitic, and in colour dark and reddish. For convenience it is called a felsite. It is rather siliceous and like the monzonite contains much arsenopyrite. Segregated masses of this rock are met with in the monzonite apparently as a product of differentiation of the magma, showing that the two rocks are genetically connected, and under certain conditions the one might pass into the other.

The latest rocks in the camp are dike rocks, lamprophyres, rhyolites and soft green dikes. These, like the granite, appear to be barren of any arsenopyrite, and are not associated with the ore bodies except perhaps accidentally.

## ECONOMIC GEOLOGY.

Camp Hedley up to date is entirely a gold producer, though it gives promise of some copper production later on.

The ore deposits belong to the class known as contact metamorphic deposits, that is to say, deposits that occur as the result of metamorphism of sedimentary rocks by igneous intrusions. The principal ore mineral is arsenopyrite, and the deposits are unique in the respect that arsenopyrite has never hitherto been found in such proportion to the other sulphides in contact deposits of this kind.

The ore bodies lie in the sedimentary rocks and particularly in the second division of the section already mentioned. The large eruptive mass of monzonite lying nearly in the centre of the camp has itself been the cause of intense contact metamorphism in the sediments that it cuts. Moreover the large number of dikes and sheets of andesite which had their source in the monzonite are also responsible for a great deal of local metamorphism. It is along the contact of these igneous rocks and in the

zone of contact metamorphism that ore bodies have been found. Primarily these igneous rocks may have been responsible for the introduction of the values, but other causes have been instrumental in concentrating these values to render them economically important.

The granite is not important in this connexion, while all the dikes have not been sufficiently studied to justify an opinion as to what influence they have exerted in the formation of ore bodies.

The more acid variety of monzonite, and the sheets which it gives off, have caused, as a rule, the most intense contact metamorphism in the intruded rocks, and apparently the payable deposits are more generally associated with this variety.

The sphere of influence of the monzonite core with its dikes and sheets covers the whole camp, but the action becomes feebler at a distance. Where the sediments have felt the direct influence of the mass the alteration has been extreme, and whole areas of what were originally calcareous rocks have been altered to garnetite.

The zone of metamorphism in the sediments varies largely with their composition and the angle at which they are cut. The calcareous rocks lend themselves more readily to metamorphism than the siliceous or argillaceous rocks. They are also more congenial for the formation of ores. Both in the Nickel Plate and Sunnyside mines the ore bodies lie in what were originally limestones, the Nickel Plate stratum having been more impure than the Sunnyside.

The contact metamorphic minerals developed in the sediments are garnet, epidote, calcite, pyroxene and actinolite, and with these are associated as ore minerals arsenopyrite, pyrrhotite, chalcopyrite, pyrite and specularite. The association of the oxides with the sulphides shows that they must have crystallized out under considerable pressure. Irregular bodies of hard cherty rock also occur near the contact, and probably owe their origin to an introduction of silica from the igneous rock.

Though the gold is always associated with the arsenopyrite, a great deal of arsenopyrite occurs scattered through the metamorphosed rock in which very little gold is found. It is almost impossible to tell, except by assay, what the value of the ore will be, for it all looks very much alike.

As a rule pyrrhotite is not associated with high gold values. Specularite, however, is a good indication. Chalcopyrite is common, though rarely in such quantities as to become important as an ore of copper. On the Warhorse mineral claim chalcopyrite occurs associated with pyrrhotite in sufficiently large bodies to make this claim a promising one, particularly as the ore also carries some values in gold and silver. Pyrrhotite is found massive on the Toronto and Galena workings and probably as a product of magmatic differentiation. On the Red Mountain it occurs in such quantities as to make the compass absolutely useless for surveying.

The Yale Mining Company own some twenty-five claims in the camp, of which only two, the Nickel Plate and the Sunnyside, are being worked at present. The ores from these claims are treated by the Daly Reduction Company in a 40-stamp mill and cyanide plant in the valley below. The capacity of this mill is about 3,500 tons per month. The mine and mill are run by water power obtained from a flume three miles long. The company own an electric tram line about a mile and a half long to carry the ore from the mine to the tipple, and a gravity tram line of 9,500 feet in length and 3,500 feet vertical height, which carries the ore in five-ton skips to the mill.

The Nickel Plate and the Sunnyside are the most important claims in the camp, and up to the close of 1906, or in less than three years, have turned out over 77,000 tons of ore. The Nickel Plate ore body lies in altered sedimentary rocks, which dip about 16 degrees to the west. Interbedded with these or cutting them at an angle are intrusive sheets of andesite. A vertical quartz porphyry and a black dike cut all these strata. The ore body now being worked lies on the upper side of a large andesite intrusion, which dips 40 degrees to the west and cuts the sediments at a sharp angle. The andesite acts as the footwall, and the ore body lies in the sedimentary rock in the zone of contact metamorphism due to the andesite intrusion. The metamorphosed rock consists of garnet, epidote and calcite carrying much arsenopyrite. The richest ore lies on the footwall and gradually fades out on the upper side into low grade rock. The greatest width of the pay ore is about eighty feet. The ore body is bounded on two sides by dikes and the third side by a zone of fracturing running across the hill. Both arsenopyrite and pyrrhotite occur, but the gold is always associated with the former mineral and the greater the mineralization by arsenopyrite the higher the values in gold.

The Sunnyside claim adjoins the Nickel Plate on the south and the ore body lies in a lower stratum. In all four workings the ore body always lies in altered limestone at or near the contact of an andesite sheet or dike. Epidote and garnet are not so abundant as in the Nickel Plate, but there is more calcite, quartz and pyroxene, all of which are more highly developed. The rock is very porous and has been much fissured, the fissures being now filled with calcite. Specularite is found in most of the Sunnyside workings, particularly on the footwalls.

In each of these claims the andesite sheets play an important part, and with other cross-cutting dikes have been the cause of confining the high values to certain restricted areas. Whether these igneous rocks are responsible for the introduction of the gold in the first place is uncertain, but the later concentration required the peculiar physical conditions that are now found in each of these claims. And in the search for other ore bodies in this camp, the apparently accidental conjunction of dikes and of dipping strata such as are here found should be borne in mind.

The Kingston group of mineral claims consists of the Warhorse, Kingston, Metropolitan and the Kingston Fraction, all lying on the Twenty-mile slope of the hill. The Warhorse ore body lies on a contact of massive blue limestone with an andesite sheet, and not far from the central core of monzonite. The limestone dips 30 degrees to the west, and carries irregular masses of cherty rock. It is cut by irregular dikes of andesite, which alter the limestone to an epidote-garnet-calcite rock. This constitutes the gangue of the ores, and the ore minerals are pyrrhotite, chalcopyrite, arsenopyrite and galena. These are scattered through the gangue in varying proportions, pyrrhotite forming with chalcopyrite the largest percentage. The chief values are in copper, but this is supplemented by some gold and silver.

On the Kingston claim farther down the hill the workings are in the sediments within a few feet of the edge of the monzonite core. Injections from the monzonite have penetrated the bedding planes of the sediments, altering and mineralizing them as in the case of the Nickel Plate mine. The chief values are in gold, which is associated with arsenopyrite. Some later dikes cut both the sediments and igneous rocks, forming favourable localities for the concentration of the gold by circulating

waters. The Kingston group of claims is very favourably situated for the occurrence of ore bodies, and more extensive development may prove their existence.

It was possible to examine only a few of the many claims in the camp, and only those on which some development work had been done. A group in the northern part of the sheet, owned by T. Bradshaw and others, gives promise of containing some valuable bodies of ore. Besides this there are many other claims, which with cheaper transportation and better facilities will be worked to advantage.

## THE LARDEAU DISTRICT, B.C.

*R. W. Brock.*

For the pages containing Mr. Brock's report, *See* Index (Brock).

# EXPLORATIONS IN THE ROCKY MOUNTAINS.

*D. B. Dowling.*

The work of the past season was directed mainly to obtaining more details of the coal areas north of the Saskatchewan and to an examination of the Athabaska valley. The explorations of the previous summer define in a general way the coal areas in the mountains between the main line of the Canadian Pacific railway and the Saskatchewan river. The route this spring lay outside this area, and some additional information was thus gained. The Foothill country which was traversed was found to have few exposures of rock; enough, however, were noted to show that in many places the tilted rocks forming the Foothill ridges were not all of the Upper Cretaceous but that many belonged to the Belly River series. A few indications of coal were seen, but nothing that appeared of economic value. The difficulty of approach naturally tends to diminish the value of measures in this vicinity. The Foothills in this region are a series of very high ridges running with the general trend of the mountains and dissected by deep transverse valleys.

The problem of accessibility will be an important factor not only for the coal of the Foothills but also for those fields situated within the mountain ranges to the west. An outlet for those just south of the Saskatchewan may be found by a devious course via the valley of a small stream north of Sheep river, but the grade to reach the Saskatchewan valley may be high.

While passing from James river to the Clearwater, behind a very high ridge, rocks were noticed closely resembling those of the Kootanie. Should this resemblance prove real, there may be found on the canyon of the Clearwater better coals than the majority of the Foothill fuels.

The uplift of the Bighorn range appears to have reached its maximum but a short distance from the Saskatchewan to the Brazeau, but evidence of an extension to the south is seen in the higher Foothill ridges. Northward they are not so pronounced, and fortunately for the future fuel supply of the northern roads they are more easily approached.

The development of mines in this district will both extend settlement to another large fertile area west of the Saskatchewan and open up a large lumbering area.

As the Saskatchewan valley is approached it presents a pleasing contrast to the rough country farther south. From high spruce covered slopes we descend to poplar groves and rich grass-covered flats. The general report from Indian trappers and traders is that the only point north of the Bow river near the mountains where surface features show prairie conditions (modified by the addition of scattered forests), is in the Saskatchewan valley. The wide river flats within the mountains are a famous resort for the Indians with their horses and cattle and we found on our arrival there in the latter part of May that horses had wintered there better than near Morley. The snowfall is less within the mountains than to the east, but it is not likely that the outer part of the valley will prove much less valuable for ranching purposes than the part we saw.

COAL AREAS.

The outcrop of the Kootanie measures on the south bank of the Saskatchewan was again visited and in addition to the seams found last year another of workable dimensions was discovered. This had a thickness of seven feet six inches, and the coal has a slightly higher fuel ratio than the five foot six inch seam found a year ago, but cokes much better. The analysis of the smaller seam was published in the Summary for 1906 (p. 72). These two seams would, therefore, appear to furnish the smaller steam coal and the larger coking.

On the Bighorn river several seams were seen in the canyon below the falls, but were not visited. About half a mile above the fall three seams that are close together could be worked as two. The lower two, separated by soft shale, have altogether ten feet of coal that in the laboratory forms a firm coke. The fuel ratio is slightly higher than in the coal south of the valley and on that account should make a higher percentage of coke per ton.

On the south branch of the Brazeau, behind the Bighorn range where the big seam was found last year, the prediction that other seams would be found in the same measures was borne out very fully. Several small ones, below workable size, were found, but eight in addition to the big seam contain sufficient coal to be workable. What was taken last year as another outcrop of the big seam is now thought to be a smaller additional one of eight feet. A fine-looking seam at the top of the lower part of the measures had eleven feet nine inches of clean coal separated from a five foot seam below by three feet of rock.

The upper portion appears to have the best coal. It is higher in fixed carbon and lower in ash. This seam and a five foot ten inch seam about 500 feet below it are the hardest coals of the district and have generally about three parts fixed carbon to one of volatile combustible matter.

The other seven known seams have an average fuel ratio as above of 2·5 parts to 1·0, and the big seam of last year is the lowest of the lot, with a ratio of 2·30.

The workable seams as far as known have the following thicknesses and come in the following order, beginning at the top. The figures are for the amount of coal in each:—

Fourteen feet 5 inches, 8 feet, 11 feet 9 inches, 4 feet 10 inches, 3 feet 11 inches, 5 feet 10 inches, 5 feet 8 inches, 8 feet 5 inches, and 3 feet 6 inches, giving a total of 66 feet 4 inches.

As only about half of the measures were prospected, there may be here as much coal as in the measures south of the Saskatchewan in the extension of the Cascade basin, namely fifteen workable seams with ninety-five feet of coal.

The generally wet weather of the past summer was very unfavourable for travel in the muskegs of the foothills. In order to reach the Athabaska valley, therefore, we descended Rocky river and examined the exposures of coal on Prairie creek, just beyond the mountains. These measures are in the upper part of the Cretaceous and do not compare very favourably with those just described. The analyses are not completed, but so far show that this coal is of about the grade of the Edmonton coal. The Prairie Creek coal will, however, be of value should an industry such as the making of cement be started near the mountains on the Transcontinental railway.

STRUCTURE OF THE RANGES.

The general type for the ranges as far north as the Brazeau has been likened to a series of long narrow blocks tilted up to form ridges—an imbricated structure. Northward this is modified in that the blocks are wider, but have suffered a great amount of folding. This lateral displacement becomes apparently greater toward the north, and many fine folds are to be seen in the Athabaska valley.

The edges of the blocks are pushed up to form the mountain chains, and do not show as many folds as are to be seen in the exposures lower down the westward slopes in the valleys. This has important results in that this folding has broken and pushed up the Cretaceous remnants, which contain coal in the mountains farther south, so that they have been carried away in the formation of the valleys. The highest rocks of this series that could be found were remnants of the black shales that lie below the Kootanie coal measures.

A notable example of this is to be seen in the first mountain at the gap of the Athabaska, called Folding mountain on McEvoy's map of the Yellowhead route. This hill is an anticline of Carboniferous rocks with a mantle of Triassic and Jurassic rocks covering its southern extension. A fault running parallel to the range just outside brings these beds against the Middle Cretaceous, and another fault to the west discloses them over-ridden by Lower Carboniferous, so that in the immediate vicinity of the river there seems no hope of finding the true coal measures. Northward the conditions may change enough to allow of some of the higher beds being found still in place.

COAL MINES.

After the field work was closed visits were made to several of the mines, and the following notes showing their progress may be of interest.

BANKHEAD MINE is producing about 1,000 tons per day, 500 of which is sized for market and 300 is compressed into briquettes. Another unit of the briquetting plant will soon be installed, and the total output will then be utilized.

At CANMORE the spur to the Sedlock prospect was nearly finished and the additional mine will soon be in operation. In the Canmore mine the main haulage way at the second level is being thoroughly re-timbered and widened to make room for compressed air haulage. A tunnel has been put through to No. 6, and the Cary seams, and mining on these will soon commence. The output should increase and is much needed for the railway.

At LILLE, to which a short visit was paid, it was found that the output was reduced to 400 tons a day on account of a fault which cuts the main seam at a slight angle. The coal is all washed and coked, making about 240 tons of coke.

BELLEVIEW is turning out about 700 tons, but an increase is expected shortly, when the management expects to handle 1,000 tons per day.

COLEMAN is mining from two of their best seams, one a coking coal and the other steam. The output is about 2,000 tons per day and most of the steam coal is shipped to the roads north of the Canadian Pacific railway.

# THE CASCADES, PALLISER AND COSTIGAN COAL BASINS.

*G. S. Malloch.*

The season of 1907 was spent in completing the survey of a portion of the Rocky Mountains Park of Canada comprising the four most easterly ranges of these mountains and extending from Panther creek to the Clearwater river. This survey was begun in 1904 by Mr. D. B. Dowling and continued last year by the writer while acting as his assistant. Mr. Dowling has already mapped a part of the Costigan coal basin which occupies the first longitudinal valley, compiling his map from the survey made in 1904 and publishing it in the Summary report for that year. He also used the first year's work for the northern part of the Panther River sheet recently published in connexion with his report on the Cascade coal basin, but the southern portion of this sheet was taken from the Palliser and Sawback sheets of the Park survey made by the Topographical Surveys Branch. While these sheets extend westward across the mountains from the second range, Mr. Dowling's sheet begins in the middle of the second valley. It is therefore necessary that the complete map of the district now contemplated should republish Mr. Dowling's work and join the Topographical Survey's sheets on the south. On the northeast and southwest the crest lines of the first and fourth ranges formed natural boundaries for the survey which was primarily intended to define the areas of coal-bearing strata that occur in the longitudinal valleys between these ranges. On the north the survey was terminated at the deep transverse valley occupied by the Clearwater river.

## PHOTO-TOPOGRAPHIC SURVEY.

In all three years' work the photo-topographic method was used for filling in the details of topography. Last year, as has been stated, our attention was devoted chiefly to the western part of the district and a large portion of the area covered was plotted on an approximate scale during the winter. It was found, however, that some additional photographs were required before the contour lines over parts of this area could be properly controlled. These were secured this summer and the eastern portion of the sheet was surveyed. In all seventy-one stations were occupied and thirty dozen photographs were taken.

## TOPOGRAPHIC FEATURES.

A general idea of the district may be obtained from the statement that it consists of four mountain ranges separated by longitudinal valleys, and crossed by three main transverse valleys which have been eroded to a depth of 4,000 feet below the ranges and 2,000 below the general elevation of the longitudinal valleys. The four ranges are in reality the upturned edges of four fault blocks shoved up by pressure from the southwest. Since erosion has removed some 7,200 feet of strata from their backs and has left them still 2,000 feet above the longitudinal valleys, an idea of the magnitude of these faults may be obtained.

As a consequence of their mode of formation, the ranges have comparatively gentle slopes on the southwest, and are usually precipitous to the northeast, where their original characteristic as fault scarps has not been greatly altered by the erosion which

has affected them since their uplift. In general the dip of the strata becomes greater from east to west across the district. This naturally increases the slope on the backs of the ranges, but decreases the width of the intervening valleys. Towards the south-east corner of the sheet, however, the dip of the strata of the first range increases and the width of the first valley decreases until it practically disappears altogether.

The transverse valleys, occupied by the three main rivers and certain of their tributaries that break through single ranges of the mountains before joining them, are characteristically flat-bottomed, and the side walls are precipitous where they cross the strong limestone strata composing the ranges. Even where they traverse the weaker shales and sandstones exposed along the edges of the longitudinal valleys, the side slopes are remarkably steep, and the tributaries draining the longitudinal valleys have gradients of at least 5½ per cent where they enter the transverse valleys. The gradient of the latter, on the other hand, is in some cases as low as 1 per cent, and does not exceed 2 per cent. Hence it is evident that all railways built to the coal fields must come up the transverse valleys.

## GENERAL GEOLOGY.

The rocks of the district are all of sedimentary origin consisting of sandstones and shales above, and of massive limestones with a single thin shale band in the lower part of the series. Their ages range between Lower Cretaceous and Devonian, but the exact geological horizon to which some of the intermediate formations should be referred is as yet uncertain. Mr. Dowling* estimates the total thickness of the exposed strata in the vicinity of Banff at 16,000 feet, and there is no doubt that this estimate applies closely to our district. Of this enormous section the greater part may be seen repeated three times by any one travelling across the ranges. This is due to the fault block structure already referred to. These faults often bring the lowest members of the limestone series into direct superposition upon the higher beds of the sandstone and shales. Had the beds been undisturbed previous to the faulting the horizons of the different beds now brought into juxtaposition would depend solely upon the throws of the faults, and might be estimated from the relative elevations of the different ranges. There is plenty of evidence, however, that the beds were traversed previously by a number of folds whose axes were not parallel with one another or with strike of the fault planes since developed among them. These planes usually dip at low angles and truncate the anticlinal portions of these old folds. The broken strata have apparently been pushed out before the oncoming limestone and eroded away. Consequently, the same fault block overrides within short distances strata of very different horizons.

The series of sandstones and shales offers much less resistance to erosion than do the limestones, and have been entirely removed from the tops of the ranges, though some of the lower members extend part of the way up their western slopes. A marine formation known as the Fernie Shale occurs in the middle of the series, and owing to its weakness the depressions in the longitudinal valleys follow its outcrop. The sandstones of the coal measures above this formation are much less easily eroded, and often serve to protect the seams at considerable elevations above the valley bottoms. In the transverse valleys many of the weaker formations are buried beneath glacial drift.

* See his report on the Cascade Coal Basin,

NORTHERN EXTENSION OF THE CASCADE COAL BASIN.

Mr. Dowling's report* describes the occurrences of coal-bearing strata in this basin from the Kananaskis river to a point some six miles north of Panther creek. Beyond this the formation extends continuously to Rabbit creek, a distance of some thirty miles, but the strip loses its value as a coal field before that point is reached. To the south, this strip is interrupted near Panther creek, where a ridge in the centre of the valley is cut off exposing the heavy sandstone at the base of the measures which is here folded into a flat syncline. This fold also appears south of the Panther, where its axis is preserved by the basal sandstone that outcrops at the tops of some hills, but which is here folded more sharply. To the north this syncline flattens out still more and approaches the fault line, finally disappearing under the limestone of the fourth range midway between Panther creek and the Red Deer. From this point northward to the Clearwater the formation dips with some regularity to the southwest and passes beneath the limestone, there being a general parallelism between the strata and the plane of the fault. In spite of this fact, the upper part of the formation (where instead of the heavy sandstones of the lower there are thin-bedded sandstones and black shales), has been considerably crumpled by the weight of the superincumbent limestone, and numerous small thrust faults occur where the crests of the folds have broken, allowing the arms to slide past one another. The strata are also cut into a large number of transverse ridges by a succession of glacial cirques formed under the overhanging limestone cliffs which have also been eroded by the ice. The distance between the outcrop of the basal sandstone and the fault line varies in different parts of the strip with variations in the topography and the angle of dip, but three-quarters of a mile is about the average. It is also quite possible that some of the lower seams may be mined for some distance vertically under the limestone, for they are roofed in some cases by from twenty to fifty feet of strong sandstones.

As stated in the Summary report for last year,‡ a section of the coal bearing strata was measured in a favourable locality between the Red Deer and Clearwater rivers. From the basal sandstone a careful examination was made of the first 1,420 feet of the measures till the further continuity of the section was rendered doubtful by a number of crumples and small thrust faults. In all 114 feet of coal were found occurring in twenty-four seams, of which fifteen were between four and a half and eleven feet in thickness. Analyses, by Mr. F. G. Wait, of samples taken from seams 3, 5 and 10 gave the following results:—

| | Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|---|
| No. 3 | 1·55 | 18·75 | 71·20 | 8·50 |
| No. 5 | 2·05 | 20·75 | 73·12 | 4·08 |
| No. 10 | 1·20 | 19·61 | 74·17 | 5·02 |

Of these the sample from seam 10, which is eleven feet in thickness, yielded a firm coherent coke. A sample also from one of the lower seams, which was collected by Mr. Dowling near the divide between the Panther and Red Deer,† gave the following excellent analysis:—

* Report on the Cascade Coal Basin, Alberta, by D. B. Dowling, B.A.Sc., 1907.
‡ See Summary Report for 1906, page 71.
† See Mr. Dowling's Report on the Cascade Coal Basin, page 35.

| Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|
| 0·72 | 21·28 | 75·80 | 2·20 |

This seam is five feet in thickness, and yielded a firm, compact and coherent coke. Three other samples, also from this basin, but representing seams near the top of the series, have been analysed. The first was collected, in 1886, by Dr. Dawson,‡ and the other two by our party this year. The results were as follows:—

| —— | Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|---|
| No. 1 | 2·9 | 29·26 | 62·95 | 4·89 |
| No. 2 | 2·14 | 23·83 | 69·67 | 4·37 |
| No. 3 | 1·58 | 25·08 | 68·60 | 4·74 |

These three samples all yielded firm cokes. Along the banks of the Red Deer the coal-bearing strata outcrop for a distance of over half a mile, and their presence in the valley of the Clearwater is also certain, though they are concealed here by deposits of glacial drift. The coal in the hills immediately to the north and south of these valleys could, therefore, be mined very cheaply from tunnels driven along the strike of the seams at the level of the valley bottoms.

### PALLISER BASIN.

This basin comprises the second longitudinal valley, and derives its name from the Palliser range, by which designation the third range from Lake Minnewanka to Panther creek is known. The width of this basin is greatest in the vicinity of Panther creek, and near it the only areas of coal-bearing strata are found. While these are five in number, only two are of economic importance, and even these are comparatively small, especially one to the north of the river. Moreover, even the basal beds of the series outcrop at an elevation of 1,000 feet above the valley, so that the construction of an expensive tramway to reach the tunnel mouths would be necessary. While neither of these areas presented sections of sufficient thickness to make them worth measuring, six seams are known in the northern and a two, and a five foot seam were measured in the southern. Samples* from these two seams gave the following results on analysis:—

| —— | Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|---|
| 2 ft | 1·13 | 11·59 | 84·94 | 2·34 |
| 5 ft | 0·93 | 10·58 | 83·55 | 4·94 |

These analyses indicate a first class steam coal very similar to that at Canmore.

### COSTIGAN BASIN.

In the Summary Report for 1904 Mr. Dowling described† this basin in the vicinity of Panther creek, and in last year's Summary Report* the continuation of the coal-

‡Annual Report, Geol. Surv., Can., Vol. I. (N.S.), p. 146 B
* See Mr. Dowling's Report on the Cascade Coal Basin, pp. 34 and 35.
† pp. 116-121.
* p. 71.

bearing strata in two areas north of the Red Deer is noted. The area on the Panther, which we shall refer to as the Costigan area, is much the most important of the three, and extends from the south branch of Panther creek to the valley of the Red Deer. On the south branch the measures are folded in a syncline whose axis pitches sharply to the north. West of this syncline an anticline occurs before the fault line of the second range is reached, but the axis of this anticline converges with the fault line, so that it is not only absent on the main stream, but the lowest coal-bearing strata on the western limb of the syncline have been overridden by the limestone. On the eastern limb the whole series, and the lowest beds of the succeeding Dakota formation, outcrop. About this point, however, the pitch of the syncline flattens, and finally changes from the north to the south, so elevating the beds that the basal sandstone is cut off by the valley of the Red Deer. Along this valley the dip is low, and the beds are undisturbed except near the fault.

North of the Red Deer, and between two of its tributaries, the coal-bearing strata occupy another extensive area, but at an elevation of from one to two thousand feet above the valley bottoms. This we will call the Big Head area, from the name of the more easterly of the two tributaries. The dip throughout this area is very regular and at a low angle, but only the lower beds of the series occur.

The third area in this basin is bounded on the south by Scalp creek, the other tributary of the Red Deer, and takes its name from it. On the west it is bounded by the fault line of the second range as far as the Clearwater, where it terminates. To the northeast its outline is irregular, which is due partly to the erosion it has undergone, and partly to a succession of folds which disturb the measures. The beds are generally at a considerable elevation above the valley bottoms, but an exception occurs in the transverse valley occupied by a large tributary of the Clearwater, where a sandstone bed is exposed on the stream itself.

While no place could be found where a complete section across the measures was exposed, it was hoped that two sections at different points might be correlated. We were unable, however, to effect this correlation owing to the great similarity between the successive beds of sandstone and shale that compose the series, and to the variations in the thickness of the same bed within short distances. There also seem to be remarkable variations both in the number and in the thickness of the coal seams at different points.

The first section was situated at the southeast corner of the Scalp Creek area, where the measures are exposed on the face of a steep hill. From the basal sandstone 1,110 feet of strata were examined, but only six seams of coal were found, with an aggregate thickness of 12·4 feet. Of these the first and fourth might be worked, as their thickness is 3·8 and 3·3 feet, respectively. A sample from the second of these gave the following analysis:—

| Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|
| 1·90 | 16·10 | 76·89 | 5·11 |

No seams were measured in the Big Head area, but coal was seen in several places.

On the northern face of the Costigan area five seams were found of the following thicknesses: 1·1; ·5; 4·2; 1·9; 5·4; 3·8 and 2·3 feet. All these seams occurred in the first 400 feet of the measures, but no other seams of any value were found above them.

Samples from the 4·2 and 5·4 feet seams gave the following analyses:—

| —— | Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|---|
| 4·2 ft. | 1·80 | 13·11 | 81·01 | 4·08 |
| 5·4 ft. | 2·14 | 15·01 | 79·73 | 3·12 |

On Panther creek a section was measured from the top of the series across the western limb of the syncline until the beds became too badly crumpled near the fault line. This section was not complete as the beds were concealed in places by drift. In 1,350 feet of strata measured, only 910 feet were actually examined. In these, twenty coal seams were found, but as all those in the upper part of the section were mere ribbons of from ·2 to 1 foot in thickness, the aggregate was only twenty-six feet. Near the bottom of the section, however, four seams occur whose thicknesses are 3·8; 4·3; 5·4 and 3·8 feet, respectively, beginning with the lowest. Analyses of the first three are copied from the Summary Report for 1904,* while that of the fourth was made by Mr. F. G. Wait from a sample brought in by our party this year. They are as follows:—

| —— | Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|---|
| 3·8 ft. | ·61 | 16·49 | 79·56 | 3·34 |
| 4·3 ft. | ·79 | 15.66 | 76·05 | 7·50 |
| 5·4 ft. | ·69 | 15·75 | 77·15 | 6·41 |
| 3·8 ft. | 1·14 | 16·27 | 78·61 | 3·98 |

Of these the first and third yielded firm coherent cokes.

Two samples have been analysed from the eastern limb of the syncline where a four-foot seam outcrops. They gave the following results:—‡

| —— | Moisture. | Volatile Combustible Matter. | Fixed Carbon. | Ash. |
|---|---|---|---|---|
| No. 1 | 1·52 | 11·65 | 81·16 | 5·67 |
| No. 2 | 1·14 | 13·63 | 80·64 | 4·59 |

These samples did not coke.

The occurrence of so many thin seams in the Costigan basin as compared with an approximately equal number of much thicker seams in the Cascade basin would seem to indicate that the edge of the original basin in which the coal-producing swamps occurred was situated not far to the east of what is now the first range. But, for the relative hardness of the coal in the first and second valleys to that in the third, and for the softness of this in comparison with that in the same valley at Bankhead, only thirty-five miles to the south, we can offer no explanation.

‡ p. 120.

* See Summary Report, 1904, pp. 119-120.

## PASQUIA HILLS AND LOWER CARROT RIVER REGION.

*W. McInnes.*

In accordance with instructions, my work for the past season consisted of a geological and, to a certain extent, topographical, exploration of the country south of the Saskatchewan river and north of the Canadian Northern railway's Prince Albert branch, with more especial reference to the tract of high land known as the Pasquia hills.

Owing to the very late spring it was found on arriving at Winnipeg that the most expeditious method of reaching the ground was by way of Prince Albert and the Saskatchewan river. The Hudson's Bay Company's steamer was accordingly taken down the Saskatchewan river as far as the outflow of the Sipanok channel, a winding stream sixty miles in length, flowing from the Saskatchewan to the Carrot river and affording, excepting at extreme low water, a good canoe route between the two rivers.

At the Saskatchewan end the land on both sides of this channel is low, though the immediate banks, built up by the sediments dropped by the flood waters of the river, rise about fifteen feet above low water level.

No hard rocks were exposed *in situ* along the route, and the land behind the above-mentioned shore ridges was found to be too low to afford much soil fit for cultivation. Areas of good white spruce occur along the stream, principally on the banks, but often extending for considerable distances inland. Very tall, clean-stemmed aspen and balsam poplar of large size are mixed with the spruces, together with smaller elm, ash, oak and ash-leaved maple.

Proceeding down stream towards the Carrot river, the banks gradually become lower until, at the confluence of the two, they are but a few feet above low water.

On both sides of the Carrot river, above the inflow of the Sipanok, large areas of hay marsh occur that become lakes at high water.

Just above where the 14th-base line crosses the river a salt spring occurs on the left bank about twenty yards back from the stream. The pool is about six feet in diameter and is fringed with a border of the little red salt plant *Salicornea herbacea* and the salt-loving *Triglochin maritimum*. The water in the spring is slightly milky in appearance, strongly saline to the taste, and gives off a very noticeable odour of sulphuretted hydrogen. A sample was submitted to Mr. F. G. Wait, the Chemist of the Survey, for examination. He says:—

'As received, the water, about one quart, contained a trifling quantity of pale-brownish-white, flocculent, organic matter in suspension, which was removable by filtration. The filtered water was clear, bright and colourless. To the taste it was strongly saline. It was devoid of any distinctive odour, and reacted neutral, both before and after concentration.

'Its specific gravity at 15·5° C. was found to be 1,024; pure water being 1,000.

'The total dissolved saline matter, dried at 180° C., in 1,000 parts by weight of the filtered water amounted to 28·14 parts; equivalent to 2017·07 grains per imperial gallon.

'A qualitative examination showed the presence of:—

| | |
|---|---|
| Potassa | very small quantity. |
| Soda | large quantity. |
| Ferrous oxide | trace. |
| Lime | small quantity. |
| Magnesia | small quantity. |
| Sulphuric anhydride | rather small quantity. |
| Carbonic anhydride | small quantity. |
| Chlorine | large quantity. |
| Silica | very small quantity. |
| Organic matter | not detected. |

'Boiling produced a small precipitate consisting, principally, of calcium carbonate, with a little magnesium carbonate, and a trace of ferrous carbonate.

'The quantity of water available was too limited to admit of search being made for the presence of bromide, iodine, baryta or strontia, or boric acid.

'The principal saline constituent of the water is sodium chloride. A proximate determination of the chlorine showed that 100 parts by weight of the water contains 15·465 parts of that element; which quantity is equivalent to 25·48 parts of sodium chloride. Portions of the chlorine may, not improbably, be combined with the calcium or magnesium, but this can only be definitely determined by a complete quantitative examination. For this there was not sufficient water available in the sample submitted to me.'

Like the brines of Lake Winnipegosis and the adjoining districts, this spring with little doubt derives its sodium chloride from the leaching out of salt crystals from the underlying Upper Silurian rocks. It is a little lower in salt content than many of the springs to the south, but higher than some.

The Indians of the district have for very many years resorted to this spring for a supply of salt, though they could not, probably, have got a dry residue by evaporation.

The same low land continues up stream, gradually rising, however, in reference to the water level, until at the Pas Mountain Indian reserve the banks are seven feet or more above low water, and on the left bank the Indians cultivate fairly large fields of potatoes. A herd of eighty head of cattle is the property of the Indians here, together with a number of horses.

We bought on July 4 from the Indians a bag of last year's potatoes that were of good size and quality and in excellent condition, and on September 13 a bag of new potatoes equally good.

Above the Indian reserve the banks gradually rise, reaching heights of thirty feet before the rapids are reached, with groves of tall aspen poplar, balsam poplar, and occasional white spruce.

At the rapids, four miles above the west line of the Indian reserve, the stream has cut its way through a ridge of boulder-clay down to the bed rock, which here consists of ledges, exposed for five feet above the water level, of a very rotten, soft, quartzose sandstone in heavy beds, deeply stained with iron oxide and with pyritous nodules. No fossils were observed, but the sandstone contains some carbonaceous material in the form, apparently, of comminuted vegetable matter. A hard, purplish quartzose sandstone, strongly ripple-marked on certain beds, probably overlies the softer beds, as it occurs in large, angular blocks falling down from the bank over these strata.

The sandstone, in certain layers, becomes a fine conglomerate with pebbles of gneiss and other rocks and shows false bedding quite clearly in places. The strata, though apparently horizontal, must cross the river in a low anticline, as both above and below the boulder-clay comes down to the water level.

Overlying the hard rocks are forty feet of boulder-clay with striated boulders of sandstone, limestone and Archæan rocks of various types.

Owing to their isolated position and the absence of fossils there are few data for fixing the geological horizon of these sandstones. They probably, however, represent a part of the Dakota sandstone division of the Lower Cretaceous, described by Mr. J. B. Tyrrell in Part E. of the Geological Survey Report for 1890-91, from several localities in the Porcupine Hills area lying to the southeast of the region under consideration The ridge of boulder-clay underlaid by sandstones, that forms this long series of rapids on the Carrot river, is seen to extend westerly toward the Saskatchewan and is said by the Indians to be continuous to the latter river and to cross it in the vicinity of Birch island between the Nipawin and Squaw rapids.

The rapids, following the meandering course of the river, have a total length of eleven miles and flow through high banks of boulder-clay for the lower five miles.

This boulder-clay gives place, half way up the rapids, to rearranged glacier material, and, three miles from the head, to recent alluvial deposits that rise only five to ten feet above the ordinary level of the river and are flooded at periods of high water, when the sediment-charged waters on their recession cover everything with a film of fine silt. High banks of lacustrine stratified clay, rising from twenty to fifty feet above the river level, follow; a few miles farther on or from unsurveyed township 51, range 8, west of the 2nd meridian, to the surveyed townships, land of very excellent quality is found on both banks. This extends back from the river in the form of a slightly rolling plateau fifty to seventy feet above the river with a rather sparse growth of small poplars. The subsoil is the stratified clay spoken of above, a lacustrine deposit that is overlain by a deep, black, loamy soil. In parts, this country might be classed with the mixed prairie and wooded lands and everywhere the open growth of small poplars makes the section one very easily brought under cultivation. The river, along this part of its course, is not more than about twenty-five miles from the Canadian Northern railway.

The only exposures of hard rock *in situ* occur about forty miles above the Red-earth Indian reserve, where fissile, soft grey shales, containing enough bituminous matter to constitute a bituminous shale, are exposed in cliffs about fifteen feet high. These shales dip to the southwest at a low angle. The remains of fishes, and other fossils contained in them, and their close resemblance to the Pas Mountain beds, (to be referred to later) show them to be referable to the Niobrara division of the Cretaceous.

West of range 13, where the townships have been subdivided, occasional homesteads are met with, occupied, for the most part by Norwegians who appear to make good settlers and who successfully raise grain and mixed crops.

The very unfavourable weather during the early spring months of this year delayed farming operations in the district considerably, but nothwithstanding these unfavourable conditions the farmers interviewed were sanguine as to their grain crops, a large proportion of which they hoped to save. Some would be cut green for profitable use as green feed for cattle, of which the settlers generally

carry a good stock. Large areas of wild hay occur all along and much of this is cut and stacked for winter use.

Though the land along this part of the river is generally of very good quality, the section lying below the surveyed townships, referred to above, seems to be of even more desirable character as it is higher above the river and has generally a heavier clay soil. Of the surveyed and subdivided lands, the area occupied by the Indians as Indian reserve 100 R, is particularly attractive. Little agricultural work is done on the reserve where it borders the river, beyond securing a fairly large quantity of the wild hay.

The most easterly ends of the Pasquia hills are situated, approximately, in N. lat. 55° 34′ and N. long. 102°. Rising on this side, first by a gentle slope from the low land and then quite sharply, they reach an elevation of, probably, 2100 feet above sea level, the height of the lowland being between 800 and 900 feet. The high land extends southwesterly gradually decreasing in height above the sea to a little over 1,600 feet and, owing to the increase in the general level of the land, becoming an elevated tract with more gradual slopes, so much so that the Prince Albert branch of the Canadian Northern railway crosses it without difficulty and by quite moderate gradients.

All about their base is a wide, flat area of hay marsh, swamp and lake extending northerly, northeasterly and easterly to the low hills beyond the Saskatchewan river. From the top of these hills, this broad, flat plain is seen to be dotted with lakes of all sizes from large bodies of water down to mere ponds. They are all shallow and without definite shore lines, merging gradually into the surrounding hay marshes. Trees and bushes occur only in groves and belts throughout the plain. From three to five miles from the edge of the lower slope of the hills a belt of marshy grass land that seems to be persistent is characterized by salt springs and brackish water and a vegetation that includes a true salt water flora.

The possibility of draining this vast plain, now too low to be of value, is a subject that deserves serious consideration, as practically all the land on both sides of the Saskatchewan, down as far as the mouth of the river, is of the same character and aggregates many thousand square miles in extent. If, as has been suggested, clearing out or excavating a drainage canal at the Grand rapid near the mouth of the river, where there is a descent of 100 feet or more in about four miles, would accomplish the purpose, the undertaking would be well worth while, but many factors must be taken into consideration; in particular, it should be ascertained to what extent the river bed is of easily disintegrated materials, and to what extent floored by the flat dolomites that would be resistant.

The enormous amount of sediment still carried down by the river and its tributaries from the south would also have to be reckoned with. Parts of the low plain near the base of the hills are being raised by the deposit of this sediment, but in general it is found that only a belt a few yards wide along the immediate banks of the rivers is being built up, the low land behind being covered nearly always in time of flood by clear water whose outlets are dammed back by the swollen river. The muddy water of the river meets this local, clear water a very short distance back from the banks, and in this practically always wooded belt the slackening current allows the water to drop part of its load of sediment, thus gradually forming an ele-

vated ridge along each bank, the low, flat land behind receiving little or no deposition from the flood waters.

The only exposures of rock in place met with on the mountain were found in gulches eroded by streams flowing down the hill-slopes. They consist for the most part of soft, grey, fissile shales that contain a considerable amount of bituminous matter, enough to cause them to burn freely with the emission of a strong odour of petroleum when heated in the camp fire. The best exposures were found in the valley of the Nabei river where a section in ascending order, as nearly as it could be made out, gave:—

Thirty-five to forty feet of thick-bedded, soft, grey bituminous shale or thin-bedded sandstone, holding the remains of fishes which seem to be *Enchodus shumardi*, large bivalves probably *Inoceramus problematicus*, and *Foraminifera*. Though the first named species range widely in the Cretaceous of northern Manitoba they occur most freely perhaps in the Niobrara.

Six inches of harder, compact, impure limestone filled with fine shells that are probably *Ostrea congeste*.

One hundred and twenty feet or more of soft, fissile, light-grey (almost black when wet) bituminous shales holding the comminuted remains of fishes and many species of *Foraminfera*. Dr. Whiteaves, after preliminary examination, states that these fossils are clearly Cretaceous and very probably Niobara. Mr. Wait found that these shales on ignition leave 70·17 per cent ash. From this the hydro-carbon content can be approximately inferred, as one-half or more of the remaining percentage would consist of hygroscopic and combined water. When heated to redness in the camp fire the hydro-carbons were volatilized and burned with a bluish flame giving off a strong odour of petroleum.

Fifteen feet of clay iron-stone beds in layers six inches to a foot in thickness with shaly partings. A sample of the clay iron-stone was submitted to Mr. Wait for examination. He says of it:—

G.S.L., No. 469, 1907.

'The sample of clay iron-stone from Pas mountain, Saskatchewan, has been found upon analysis, conducted by Mr. M. F. Connor, to contain :

| | |
|---|---|
| Metallic iron | 29·10 per cent. |
| Insoluble mineral matter | 9·20 " |

Ten feet, soft, fissile, grey shale, probably quite similar to the thick beds below.

A varying thickness of boulder clay, the boulders chiefly of limestone but occasionally of Archæan gneiss.'

Near the eastern end of the hills the bituminous shales were again found in the brook valleys. Their occurrence here and in the valley of the Carrot river, as noted on a previous page, shows that they underlie the whole extent of the hill country.

The Pasquia river for forty miles or more above its mouth flows through low land with extensive hay marshes and shallow lakes. At a distance of about thirty miles from the mouth, just about at the eastern boundary of Saskatchewan, it forks with two branches, the northerly branch approaching close to the Carrot river at the second meridian, and heading in small streams coming down from the hills, and the southerly branch taking a great sweep to the south, crossing the new branch of the Canadian Northern railway at two points, and heading also in the hills. To a point

some distance above the forks the stream is deep and smooth, with low banks. On the main or south branch above this point rapids are numerous where the stream flows through boulder clay which forms banks here and there twenty-five feet high.

Some good spruce and poplar occur along the river but there is little land suitable for settlement. Both branches, after leaving the hills, flow through a great hay marsh and swamp where their channels are often indefinite and not navigable even by canoes. There are two Indian reserves on the lower Carrot river, both situated near the northeastern end of the Pasquia hills, one at Red-earth lake and the other at Shoal lake. Both bands, as they are cut off entirely, owing to their isolated position, from other employments, are hunting Indians who depend largely on their catch of furs for subsistence. Both, however, raise enough potatoes to supply their immediate needs and to carry over the winter for use in the following spring and summer. They even exported a small quantity from Shoal lake to the Pas village. A few horses are kept on each reserve and small herds of cattle. At Red-earth there was a herd of upwards of eighty cattle, the property of the Indians themselves, who appear to take considerable pride in them and who keep them in good condition. The band at this reserve, everything considered, appear to be more comfortable and contented than any other band of Indians with whom I have come in contact in the northern country.

Of large game the moose is by far the most plentiful. They range during the summer months in great numbers over the flat land between the hills and the Saskatchewan river, retiring to yard during the winter in the higher land and on the slopes of the mountain. The smaller red deer is fairly plentiful along the upper parts of the Carrot river where the land is fairly high. Black bears are fairly numerous, and the ordinary fur-bearing animals of this latitude are not uncommon. A large colony of beavers was observed at work on the Carrot river. They had built a good sized house and were starting work on a dam across the river. Several species of ducks and a few Canada geese breed in the district and both are found in very large numbers at the time of their autumn migration, when they form the staple food of the Indians.

The fish of the region are neither very good nor very plentiful owing largely, probably, to the absence of deep lakes and clear-water rivers. Sturgeon, whitefish and doré are caught, however, and pike and suckers are plentiful.

Good white spruce grows in a belt of varying width along the Sipanok channel and down the Carrot river. Mixed with the spruce are poplars, aspen and balsam, which grow to be large trees with tall, clear trunks. On the flanks of the hills aspen and spruce of merchantable size are found. The best trees, however, occur on the mountain side 500 feet or thereabouts above the plain. Here are tall, smooth-trunked spruce of large size with occasional large white birch, elm and aspen. On the upper Carrot, above the long rapid, areas of very excellent spruce occur and between the two branches of the Pasquia is an area that promises to yield a good quantity.

Since my summary report of last year was submitted Dr. Whiteaves has more definitely determined the set of fossils brought in from Cormorant lake and its vicinity. This later determination confirms the conjecture, then hazarded, that all these dolomites are of Cambro-Silurian and about Trenton age. The northern boundary of the Silurian is thus brought somewhat farther south than was before supposed to be its position, nearly down to the Saskatchewan, in fact.

The great plain of the lower Saskatchewan and Carrot rivers is, therefore, probably immediately underlain by Silurian, and the lower slopes of the mountain, where all exposures are concealed, by whatever thickness of Devonian may intervene between the top of the Silurian and the Lower Cretaceous beds exposed at the rapids on the Carrot river.

Surveys by Rochon micrometer telescope and surveyor's compass were made of the Sipanok channel, Carrot river from the long rapid to the mouth and Pasquia river from the forks to the mouth. Track surveys were made of the upper branches of the Pasquia river, of the Carrot river from the long rapid to township 48, 13° west of the second meridian and of tributary streams flowing from the Pasquia hills into the Carrot and Pasquia rivers.

Mr. Chester P. Brown, of Paris, Ont., a student at Toronto University, acted as my assistant during the summer and gave entire satisfaction.

7-8 EDWARD VII., A. 1908

# EXPLORATIONS ALONG THE NATIONAL TRANSCONTINENTAL RAILWAY LOCATION FROM STURGEON RIVER WESTWARD.

*W. H. Collins.*

The field season of 1906 was devoted to explorations of a twenty-mile belt flanking the proposed course of the National Transcontinental railway between Lake Nipigon and Dog lake. This year work of the same nature was continued westward as far as Clay lake, some forty-five miles northeast of Kenora. The combined seasons' reconnaissance covers a tract 216 miles long and about twenty-five miles wide, traversed medially by the railway location.

On the way to the field the writer was enabled, through the courtesy of the Director and Professor Leith of the University of Wisconsin, to join the biennial geological excursion to the Lake Superior iron ranges, organized by the Geological Department at Madison. This year the party consisted of about twenty members from Wisconsin and northwestern universities under the direction of Professor Leith and Dr. Grant. The Penokee Gogebic, Vermilion and Mesabi ranges were visited and some conception of the ore deposits and methods of handling was gained, besides a visual examination of the geological environments of each range. In view of the advanced nature of the mining operations and the detailed geological knowledge which has been accumulated concerning the origin of these enormous ore bodies, the visit proved of especial value for purposes of comparison during the subsequent field work in Ontario.

The entire party to be engaged in field work during the summer, six in all, assembled at Osaguan on May 29, and set out for Sturgeon lake, which was reached on June 7, after considerable delay owing to the persistence of the ice, vestiges of which remained until the middle of the month. Work was commenced on Savanne lake on the 11th. and progressed steadily until Sept. 20. A party of four was engaged continuously surveying the waterways of the country while the writer attended to the geological exploration.

## GENERAL TOPOGRAPHY.

The area covered this year, like that of last season, is a peneplain of crystalline rocks thinly and unevenly soil covered and, for the most part, forested with evergreens. Rounded, rocky-summited hills up to 200 feet high, disposed in confusing irregularity, are the dominant topographical feature. Well defined valleys and continuous ridges hardly exist. The lower levels are soil covered. Thick deposits of soil are unusual and of local extent, being either till or stratified materials laid down in their valleys by streams.

The entire area drains northward and westward into English river, the principal tributaries being the Sturgeon and Wabigoon. On account of the prevalent flatness of the region, none except the smaller brooks flow rapidly. Rapids and waterfalls are infrequent. Indeed, so trifling is the slope, the smaller southern tributaries of Lac Seul (an expansion of English river) flow up stream with perceptible current when, during periods of prevalent westerly winds, the level of the lake has been slightly raised

by retardation of its flow. Sturgeon and English rivers are, at most points in their course, lake-like rather than river-like in appearance, having widths of from one-half to four or five miles, irregular rocky shores and no visible currents except at occasional constrictions in their channels where rapids or cascades obtain. The paucity of soil, slight gradient and the resistant character of the rocky floor, are directly responsible for these peculiarities. Wabigoon river, however, and all its feeders, traverse a broad clay-filled valley, in which favourable material they have developed true fluviatile characters,—parallel banks, uniform gradient and consequent infrequency of rapids and falls.

Lakes, due to the same features that give Sturgeon and English rivers their peculiarities, are remarkably numerous and often of large size. Lac Seul is about eighty miles long, Minnitaki thirty. Any part of the region is accessible by canoe and certain chains of lakes, since the commencement of railway construction, are traversed by lines of small steamers and gasoline launches.

## GEOLOGY.

The rocks of this area fall easily and naturally into two groups: (1) an older series of fine-grained eruptives and sediments of Keewatin and probably also Lower Huronian age; (2) a later intrusive series of pale-coloured granites and gneissoid modifications of the Laurentian period. The latter occupy much the greater area, forming, when geologically mapped, the ground colour upon which appear two elongated patches of schists.

The more easterly of these patches extends as a narrowed tongue from the main body around Savanne lake southwestward along the Dog river ,pointing out about eight miles above its mouth. The band is about five miles wide at its base and tapers gradually. The second schist body is widely elliptical in form, enclosing Lake Minnitaki; its major axis extends about fifty miles in a southwesterly direction from just south of Dog lake to Gull lake. Its northern edge lies from one to five miles south of the N. T. C. Railway location, crossing it, however, at Lost lake; the southern boundary is defined upon Geological Map Sheet No. 5 of this Department.

All the members, both igneous and sedimentary, of these areas dip perpendicularly or at high angles and extend northeast and southwest in the direction of the major axes. The igneous members are porphyries, porphyrites and diabases more or less altered to schists. They are identical with the original Keewatin group. Associated with them is a series of sediments, also metamorphosed, whose most conspicuous member is a conglomerate of granite, quartz and fine-grained eruptive pebbles enclosed in a matrix varying in texture from a grit to glossy chlorite schist. This conglomerate passes, by the thinning out of its pebbles and by gradations in the texture of its matrix, into slates accompanied by banded quartzite and iron ore bands. The group presents analogies with the Lower Huronian elsewhere in Ontario. At the time of Laurentian intrusion both eruptives and sediments were given highly tilted altitudes which, along with the acompanying metamorphis, has obliterated their planes of contact and rendered distinction difficult. The presence in the conglomerate of greenstone pebbles suggests a time gap between it and the Keewatin.

The Laurentian, at first sight an unintelligible complex of granite, gneiss, diorite and pegmatite, must be considered as the product of differential plutonic intrusion of a granite magma into the older Keewatin and Huronian rocks. As now exposed it

consists of biotite-gneiss and granite grading from one to the other ,and containing, particularly in the gneisses, masses of diorite-like inclusions and basic, hornblende-bearing schlieren, the whole being cut by dikes and bosses of pegmatite. A comparison of various specimens of the pegmatite and granite does not disclose much difference in texture or composition between the coarser granite specimens and the finer pegmatites. Rather ,they form a graded series marked by: (1) an increasing coarseness of texture, accompanied by (2) a corresponding increase in silica and alkalies.

The schists at their contact with the gneisses have been altered to a crystalline hornblende schist and within the adjacent Laurentian are angular blocks of the same material. Observation of their inclusions at various points, and the basic, drawn-out schlieren, admits of their correlation by a second graded series of forms varying in definition of outline and basicity. Practically every rock type observed in the Laurentian formation this season may be referred to either the granite-pegmatite igneous group or to the hornblende-bearing inclusions. Under deep-seated conditions, a magma, initially of the composition of biotite granite but towards its final stages growing richer in alkalies and silica, slowly intruding an older formation like that of the schists, might be expected to produce a complex similar to that above described.

## MINERAL DEPOSITS.

### *Iron.*

Attention was directed last* year to the existence of magnetite west of Savanne lake. Since that time a number of prospectors have visited the range and staked some twenty claims. To gain more definite information a second visit of about two weeks' duration was made in June of this year ,and surveys, to provide for the compilation of a hand map of the locality, were undertaken. The country is thickly forested and a covering of moss and soil conceals the rocks. For this reason geological examination was restricted to the lake shores where exposures are almost continuous. In some places the iron formation where concealed was detected by the use of a dip needle.

The northern boundary of the schists is only a short distance north of Kashaweogama lake, extending thence northeasterly to Savanne and westerly to the south end of Cliff lake. They continue for about three miles south of Kashaweogama and Island lakes. A wedge of Laurentian enters between Cliff lake and the south shore of Island lake, all running westward to Kashaweogama. All the schists dip steeply and strike at from 200° to 240° except in the strip reaching to Cliff lake. An igneous and a sedimentary series occur, but relationships and their actual boundaries are obscured by their highly altered condition. Chlorite and sericite schists are the principal forms seen on Houghton lake and the south side of Island lake. Most of these are probably altered eruptives; however, both types are met in the sedimentary series at points where faulting or shearing has taken place. The development of chlorite and sericite schists from sedimentary material is observable in the conglomerate matrix which varies within narrow limits from a distinctly clastic grit to smooth schistose rock substance. This dual development of chlorite and sericite during the folding and compression of the

* Summary Rep. G. S. C., 1906, p. 106.

Keewatin and Huronian has helped to obscure any original plane of separation between true sediments and true eruptives. Greenstones of rather massive character appear on Pickerel lake. On Cliff lake, Kashaweogama and eastward to Savanne true sediments predominate. A band of conglomerate about 100 feet wide extends from Island lake along Kashaweogama for two-thirds of its length, appearing farther east on Iron lake. A broader conglomerate body lies just east of the Savanne narrows. On both sides of the first mentioned band are dark-coloured siliceous slates which grade insensibly into the conglomerate matrix. These slates contain the iron formation, consisting of alternate bands of quartzite (jaspilite) and siliceous magnetite, slate and chlorite schist. The magnetite bands, ranging from less than an inch to several feet in width, extend indefinitely in the direction of rock strike.

The iron formation exists on both sides of Kashaweogama lake on the portage between Island and Cliff lakes; it outcrops over a width of about 1,000 feet. Eastward the country is swampy and the rock formation hidden. At a mile north of the east end of Kashaweogama magnetite bands were detected by the dip needle beneath a covering of sand. The formation appears again near the north end of Iron lake, on the portage to Savanne lake and at numerous points just above Savanne narrows. At all these points the seams of ore are narrow and siliceous and of no value.

The south side of Kashaweogama is better mineralized. The belt is at least a quarter of a mile in width and contains bands of ore from seven to sixteen feet wide. These extend from a point midway along Kashaweogama to within a short distance of Grebe lake. An average specimen selected from a sixteen foot band was analysed by Mr. F. G. Wait of this Department and reported on as follows:—"Sample of iron ore from a point situated about ten miles west of Savanne lake consists of an intimate association of magnetite, with some hematite and a larger proportion of siliceous—mainly quartzose—gangue. It has been submitted to analysis and found to contain:—

| | |
|---|---|
| Metallic iron ..... ..... ..... ..... ..... .. | 30.74% |
| Insoluble siliceous residue ..... ..... ..... ..... | 55.70% |
| Titanic acid ..... .... .. ..... ..... ..... | None. |

Analysis of another specimen, obtained from the laboratory of the Atikokan Iron Mining Company yielded 53½% of metallic iron.

The geological surroundings are quite comparable with those of the Vermilion range of Minnesota. Iron oxide exists within the slates in considerable amount, but as yet no favourably situated dikes have been found. However, the surface is so hidden by forest growth that their absence cannot be inferred. Dikes cross-cutting or forming a wall of impervious pitching troughs must be sought for in the exploration for ore. The existence of hematite in association with the magnetite is favourable, but unlike the jaspilite of Timagami and Vermilion ranges, the Kashaweogama quartzites are in dull grey and black tones, red bands being infrequent. The claim owners are in expectation of seeing a diamond drill at work next season.

In the schist area enclosing Lake Minnitaki magnetite bands also occur under geological conditions identical with those at Kashaweogama. At Sioux Lookout, just below the junction of the English and Sturgeon rivers, the vertically oriented slates contain iron ore bands, which, however, are narrow and commercially valueless. Iron ore in small quantity has been found near Hidden lake on the north side of Sturgeon

river. The interval between the two points has been investigated, but as the direction is that of the general rock strike the mineralization may be continuous.

### GOLD.

While en route to Savanne lake a brief visit was made to the Sturgeon Lake gold mining district. Work had been suspended at the St. Anthony Reef mine at the end of March but was expected to be resumed with the opening of navigation upon Sturgeon lake. At the close of working the 100 foot level continued to show abundance of mineralized quartz and schist yielding average values of $10.67 per ton, about 60% of which was free milling, the remainder in the pyrite concentrates which formed about 7% to weight crushed. Some prospecting to the east of Couture lake had revealed a vein carrying free gold, pyrite, chalcopyrite and a little native copper. In Belmore bay the Douglas Mining Company and Messrs. Fawcett and Bourion had, during the winter, erected excellent camp buildings in expectation of beginning mining with the coming of spring.

Small quartz veins carrying free gold are reported from the schists of Dog river just north of the second lake expansion, by Mr. Estrom, a prospector. Free gold in small amounts is also reported from about Minnitaki and English river.

At a point about five miles S.S.W. of the Hudson's Bay Company's factory on Lac Seul, the writer in examining the beach sand obtained a single small colour of gold. The sand consists of quartz, garnet, magnetite and greenstone grains, some of which no doubt are disintegrated Keewatin material; a small amount of gold may have been obtained from the same source. Sands of this character are very abundant on Lac Seul.

### PYRITE.

The Keewatin rocks everywhere contain a considerable amount of pyrite in disseminated crystals and small concentrations. Quartz veins in that formation are usually pyritiferous. A large body of pyrite on the northeast of Vermilion lake, whose existence has been known for a number of years, is now being exploited by the Northern Light Mining Company, representing New York capital. A clearing of about twelve acres has been made, camp buildings have been erected and a wagon road three miles long has been cut to Vermilion river from where a gasoline boat connects with Minnitaki. Forty men were at work. Development thus far has been exploratory and no atttempt has been made to mine and ship the ore. A vertical 6 x 8-foot shaft, 103 feet deep, has been sunk so as to intersect the ore body and at 86 feet drifting in a north and south direction was being advanced in July. One drill and the shaft hoist are operated by steam power. The ore body fills a fissure extending from beneath the lake in a northeasterly direction. The rock on either side is a somewhat sheared diabase. The ore is a fine-grained pyrite containing some silica and a little chalcopyrite. At the 86-foot level a southerly drift of about 20 feet shows solid ore and no sign of the wall.

An outcrop of pyrite associated with magnetite was noticed on the English river just south of Pelican lake. It is only a few feet wide and, from surface appearance, of no value.

### FELDSPAR AND MUSCOVITE.

Pegmatite dikes and bosses are a characteristic feature of the Laurentian formation. These are composed of acid, alkali-rich coarse textured rocks probably representing the ultimate stage of Laurentian intrusion. Quartz, feldspar, mica and magnetite are the ordinary constituents. Usually the pegmatite bodies are only a few inches or feet across. However, just south of Gull lake, is a more extensive mass in which the crystallization is coarser than usual. Feldspar occurs up to eighteen inches in diameter and mica in sheets sometimes six inches across, the latter frequently occurring in two zones parallelling the streaks of quartz which run for short distances. The muscovite quarries of the United States are situated in pegmatite veins and coarse granites similar in general character to the rocks at Gull lake, although often the home of rare minerals not as yet seen in the Canadian occurrences. Those of the Black hills in Dakota most closely resemble the Ontario forms, the mica being one constituent of a coarse granite. The muscovite 'books' at the surface of the Gull Lake granite are weathered and have lost much of their resiliency, but beneath the surface a better quality no doubt exists. The sheets obtained at the surface could be trimmed to two by two inches and three by three inches, scarcely larger, none being seen exceeding six inches across.

### SOILS, ETC.

All the inorganic soils distributed over the region are of glacial detritus. In many places the original deposits from melting glaciers are preserved much as originally laid down. Boulder clay is scattered locally over the whole area, but the heavier, continuous deposits lie to the south of Lac Seul between lats. 92° 15′ and 92° 45′. High banks of sand are exposed along the shores of Lac Seul. Railway grading west of Lost lake has exposed splendid transverse sections of sand ridges laid down by streams at the edge of glaciers, the sand possessing a convex bedding. Much of the country south of Rock lake and around Gull lake is heavily covered with sandy or loamy till. Certain other soils have been laid down in well stratified beds. As far as Clay lake the Wabigoon and its tributaries occupy a valley filled with bedded clays, forming an area about thirty-five miles in length and from five to ten miles wide. These clays are horizontally beddddded in thin gray or red laminae. For agricultural purposes the Wabigoon clay is excessively tough and impervious to moisture, tending to bake firmly in dry season and flood during wet weather. A considerable farming community exists around Dryden and a few settlers live along the Wabigoon as far as Minnitaki station. Hay grows in some luxuriance along the shores. The till deposits above mentioned are nowhere under cultivation. An exceptionaly large proportion of arable land is comprised within the limits of Indian Reserve No. 28.

The timber seen this year is of much finer quality than that between Lake Nipigon and Sturgeon lake. Both white and red pine are common from Dog lake westward, but are confined to small areas, usually forming clumps and groves on sand ridges. A large grove of both varieties seen at the north side of Pine lake contained individuals three feet in diameter. Red pine, eighteen inches in diameter, was commonly met south and west of Lac Seul. Banksian pine is abundant and of a size suitable for making railway ties, forming the chief source of tie timber for National Transcontinental Railway construction purposes. Spruce is prevalent everywhere, tamarack much

less so. At fifteen miles above the mouth of Dog river is some excellent tamarack, specimens measuring from ten to twenty-four inches in diameter. Poplar and birch are the chief deciduous trees, specimens of the former on Gull river reaching thirty inches in thickness; yellow birch eighteen inches in diameter was measured on Dog river. Elms and an occasional oak grow in the Wabigoon valley. Timber growth, where deep soil exists, is rapid and trees grow to a large size. Unfortunately much of the country has been devastated by fire. Practically no live timber remains in the Wabigoon valley and, recently, fires have run over the country between Sturgeon river and Lake Minnitaki.

Water power is available on Wabigoon river at the National Transcontinental Railway crossing where a fall of twenty-five feet occurs. Also at Pelican falls on the English river, the descent being about thirteen feet. Both these are within very short distances of the railway line. Smaller powers are available at the mouth of Dog river and the head of Pelican brook.

Access to the country has been greatly facilitated since the advent of railway construction. A line of small steamers and a nine mile stage line connect Abram chute with Dinorwic. A wagon road eighteen miles in length runs north from Dryden to the National Transcontinental Railway location and another road, nine miles long, connects Wabigoon falls with Vermilion bay.

# SHORE LINES BETWEEN GEORGIAN BAY AND THE OTTAWA RIVER.

*A. F. Hunter.*

On May 20 I began the work of tracing the 1,040 feet shore line in the country east of Georgian bay, and completed the investigation in July. In ordinary circumstances the broad water plain of this shore line makes it an easy one to follow, regardless of whether the margin is well defined or not. But the irregular, rocky surface of the Laurentian areas throughout the district which it was necessary to traverse, introduced practical difficulties of no light kind.

On the interlake peninsula surveyed in 1905 I had found this compound shore line to include three strands at about 1,080, 1,040 and 1,000 feet, respectively; and as already mentioned in the report of that territory, I had adopted the middle one to define the whole group. From the examination of this new territory, I obtained no results differing from those of the interlake peninsula, except that of greater denudation on the Laurentian. The harder rocks of the latter are much less drift-covered than the Silurian rocks of the former, and, accordingly, the covering of drift over the Laurentian is very scanty in most places.

The foregoing remarks apply only to the main mass enclosed by the 1,040 feet shore line on the Laurentian. This mass is roughly quadrilateral in shape, with an elongation toward the southeast, and another toward the west, in accord with the two systems of rock foldings, commonly found throughout the district.

On the other hand, the 1,040 feet shore line through southern Ontario encloses islands of thick drift deposits. These I had traced and examined in the fall of 1906, with the exception of Durham county.

During August, 1907, I made the circuit of the 1,430 feet shore line in the central parts of the high tract under review, viz., between Georgian bay and the Ottawa river. The map and report prepared and submitted herewith give the main features of this shore line so far as it was practicable to investigate them.

The examination of the three shore lines thus completed brought out the fact that they approach each other on the northeast quarter more closely than elsewhere. There is much bolder relief of the land along this face, and here there has been much greater erosion of the steeper declivities.

A unique alteration takes place in the shapes of the land areas enclosed by the three shore lines respectively. The lower, or 790 foot area, is elongated in a northeast and southwest direction. The 1,040 foot area is quadrilateral; and the 1,430 foot area, or oldest of the three, has its longer axis from the northwest to southwest in agreement with the strike of the Laurentian.

## PETERBOROUGH AND SIMCOE SHEETS.

*W. A. Johnston.*

During the past season the mapping of the Simcoe sheet was continued according to instructions.

On May 27 I proceeded to Kirkfield, Ont., where I was joined by J. H. Stothers, of Ottawa, Jas. Hill, M.A., of Stratford, Ont., and Bert R. McKay, of Cornwall, Ont., who acted as my assistants throughout the season's work, which lasted until Oct. 4.

In July and August, while the mapping of the Simcoe sheet was being carried on by my assistants, some four weeks were spent by me in making necessary surveys in connexion with the mapping of the Peterborough sheet, in obtaining a series of photographs of that district and in an examination of the outcrops of Utica shales and Trenton limestones, along the shore of Lake Ontario eastward from Whitby, with a view to defining the contact of the two formations, and including in the Peterborough map sheet the strip of country along Lake Ontario from Whitby to Trenton.

Exposures of Utica shales occur at Whitby, Oshawa and Bowmanville, but over most of the area a heavy mantle of drift obscures the surfaces of the rock. In a bore-hole at Whitby the Utica shales were found to have a thickness of seventy feet. At Oshawa and Bowmanville they merely form a capping a few feet thick over the Trenton limestone. The beds dip towards the north and occupy a basin-shaped area the exact limits of which could not be determined on account of the great accumulations of drift.

The Simcoe sheet lies adjacent to and west of the Peterborough sheet and embraces an area of forty-eight by seventy-two miles, the central portion of which is occupied by Lake Simcoe. In undertaking the mapping of the Simcoe sheet it was thought advisable to introduce contouring, in order that as complete and accurate a topographical map as possible might be produced. To this end instrumental levels were taken over all the roads in the area mapped during the summer, which included the greater portion of the sheet lying east of Lake Simcoe, and the work was plotted and the contouring and topography done in the field, thus ensuring greater accuracy than would otherwise be possible. In this work bicycles were used as a means of traversing the roads and by their use we were enabled to accomplish more than would be possible either on foot or with horse and rig.

Very little work had previously been done, by officers of the Survey, in this portion of Ontario, and the mapping of the eastern part of the Simcoe sheet has resulted in the acquisition of much knowledge concerning the distribution and occurrence of the Trenton, Black River and Birdseye limestones, which underlie most of the area, and of the Archæan rocks occupying the greater part of the townships of Digby and Dalton in the northeastern corner of the sheet.

The Head river, which forms the south branch of the Black river, flows for some distance, after issuing from Head lake, along the contact of the limestones with the granite and gneisses. At Uphill and Dartmoor two outliers of limestone have been formed by the river cutting a deep channel through the main body of the limestone,

at a time probably when that rock extended much farther over the Archæan areas to the north. The lower end of Mud lake is occupied by Archæan rocks. The upper end occupies a shallow basin in the Black River and Birdseye limestone and drains north into the Head river. At Sebright the contact is again seen, the limestones forming a bold escarpment which strikes in a northwesterly direction towards Lake St. John in Rama township.

Along this northern border of the limestone series numerous sections are exposed of the limestones and shales underlying the Trenton formation. In a section measured just west of Head lake there was found to be at the base twenty feet of red and green shales with occasional thin beds of coarse sandstone or grit, resting on two or three feet of rotten granite. Scattered through the shales are numerous crystals of marcasite and small rounded pebbles of quartz, but no fossil remains could be found, with the exception of *Scolithus*-like markings in the arkose at the base, which fossil, however, is of little value for the determining of horizons. The shales are calcareo-argillaceous in character, soft and friable, readily weathering where exposed, and forming the rich red soil characteristic of the areas near the contact of the limestone series with the underlying Archæan rocks. The red and green shales pass upward into fine-grained, evenly-bedded, greenish-grey and dove-coloured limestones having a total thickness of fifty feet. The greenish-grey beds are somewhat arenaceous and are generally devoid of fossils. The upper twenty feet of this portion of the section is composed of dove-coloured stone, lithographic in physical character. These beds are characterized by a great abundance of a species of *Leperditia,* a *Bathyurus* and numerous small tube-like forms filled with calcite, and beds of the same character and containing the same fossils are interbedded with the greenish-grey arenaceous beds towards the base of the section. The whole section is capped by ten feet of massive dark-coloured beds containing an abundance of the characteristic fossils of the Black River formation such as *Columnaria halli, Stromatocerium rugosum,* &c. None of these fossils was found in the underlying beds and there is quite a distinct line separating the fine-grained *Leperditia* beds from the heavy dark beds of the Black River.

At Coboconk a good section is exposed of these massive dark-coloured beds, which are regarded as belonging to the Black River formation, showing the contact with the underlying fine-grained *Leperditia* beds and also the contact with the overlying Trenton. The Black River beds here have a total thickness of about twenty-two feet.

The Black River formation may be used as a datum plane in that it is continuous from the east to the west side of the Frontenac axis both in Ontario and in New York state.

On the east side of the Frontenac divide there is the regular succession down through the Black River, Chazy, Calciferous and Potsdam. On the west side of the divide in New York state, according to Prosser and Cumings* the Chazy is not at all, and the Calciferous only partially developed; and the next formation below the Black River is referred by them to the Birdseye (Lowville). This formation consists of compact dove-coloured limestone, apparently quite similar to the fine-grained *Leperditia* beds described in the above section. In the section near Trenton Falls, N.Y., as described by Prosser and Cumings, the Birdseye limestones become somewhat aren-

* Report of State Geologist, N.Y., 1895.

aceous towards the base, and pass downwards into calcareous sandstones, regarded by them as Calciferous in age.

Similar limestones occur in the Kingston district of Ontario, and regarding them Dr. Ells says in the Summary Report for 1901: 'In physical characters, the lower portion of the limestone formation north of Kingston resembles some of the limestones of the Chazy formation of the Ottawa district.' So far as known, however, no typical Chazy fossils have been found west of the Frontenac axis. It is possible that these fine-grained beds below the Black River formation are equivalent in time space to the upper part of the Chazy of the Ottawa district, yet in the absence of fossil evidence, which would serve to correlate these beds directly with the Chazy formation, it seems preferable to refer them to the Birdseye, as is done in New York state.

Throughout the Peterborough district these beds, which are regarded as belonging to the Birdseye formation, rarely exceed thirty feet in thickness and have, generally, at their base a few feet of calcareous grit or arkose derived from the immediately underlying crystalline rock. In some cases the Black River beds rest directly on the crystalline and have a similar arkose at their base. In a section exposed near Burleigh Falls at the base of the limestone series a six-inch bed of typical Birdseye limestone was found to be overlaid by two feet of calcareous grit, and at the Burnt River quarries the Birdseye limestones become interstratified with arenaceous beds towards the base of the series. Hence it would appear that over part of the area at least the grit and arkose beds are merely a local development at the base of the limestones.

In the Simcoe district the beds below the Black River have a thickness of over seventy feet, including twenty feet of red and green shales at the base, and whether the whole series should be referred to the Birdseye formation is not certain.

The Black River limestone, when free from chert, is chemically purer than either the Trenton or Birdseye, and is more extensively used in the manufacture of cement and lime. In the Simcoe district good exposures of the Black River beds occur in Carden township.

Occasionally large masses or seams of fossiliferous chert occur in these beds and, where accessible, would no doubt prove valuable for use as road metal. On lots 11 and 12 of concession 3 of Carden township, a seam of chert six to eight feet wide is exposed for a distance of ten chains.

# AN AREA FROM LAKE TIMISKAMING EASTWARD.

*Morley E. Wilson.*

As the geological formations, which in Ontario have been found to contain silver-cobalt-nickel ores, were known to extend eastward into the province of Quebec, an examination of the area to the east of Lake Timiskaming was undertaken, during the summer of 1906, with a view to obtaining more detailed information in regard to the geology of the district. The area of Huronian and Keewatin rocks was found to be too extensive for their examination to be completed, the work of the season being confined to the townships of Guigues, Duhamel, Fabre and the surveyed portions of Baby and Laverlochere. The present field season was spent in the region immediately to the east of these townships, thus completing the surveys necessary for a geological map of an area extending along the east shore of Lake Timiskaming from the Quinze river to the south end of Fabre township, and eastward to Lake Kipawa and Lac des Quinze. A preliminary map of last year's field work has already been published; this, however, will be included in a final sheet of the whole area on the scale of one mile to the inch.

I was assisted during the past season by Messrs. Douglas Ells, Gerald Galt and W. L. Carr, all of whom rendered willing and efficient service in the accomplishment of the work.

## PHYSIOGRAPHY.

The east shore of Lake Timiskaming from Lavallee bay to Apika creek presents a somewhat rugged appearance, due to a succession of quartzite ridges which rise abruptly to an elevation of from two to three hundred feet above the lake. From Apika creek to the Quinze river, and extending throughout Guigues and eastern Duhamel, a large clay area occurs. This comprises roughly the lower part of the basin of the Otter river. There are also smaller areas of clay or sand throughout southern Baby and northern Laverlochere. The southern portion of the sheet is characterized by numerous low, rocky hills whose rounded contours, denuded of vegetation by forest fires, form a marked physical feature of the region.

The lakes of the area are confined largely to northern Baby and the neighbourhood of Lake Kipawa. In the latter district they are exceedingly numerous and show in nearly every case a northeasterly or northerly parallelism in the trend of their basins. The lakes of the first class are shallow and correspond in direction to the strike of the gneiss in which they occur; those of the second class are deep and apparently have no relationship to either the strike of the rock or to the direction of glacial movement.

A few of the lakes in the southeast part of the sheet have their outlet into Lake Kipawa, but with this exception, the drainage is almost exclusively into Lake Timiskaming. In the more rocky districts the streams abound in rapids and waterfalls but elsewhere they meander through clay flats with little current, save where an occasional outcrop of rock obstructs their course.

## GEOLOGICAL SUCCESSION.

The geological sequence on the Quebec side of Lake Timiskaming is very similar to that found in Ontario. The oldest series in the district, the Keewatin, consists of

greenstone, green-schist, quartz-porphyrite and serpentine. Through this igneous complex a Pre-Huronian granite has been intruded. The latter and the Keewatin are overlain in places by the Huronian, the basal member of which is a conglomerate. This conglomerate grades up into greywacké, which in its turn changes gradually into arkose or quartzite. Quite frequently, however, the greywacké and conglomerate are entirely absent, the arkose resting directly upon the granite from which it is derived by decomposition *in situ*. The deposition of the Huronian was followed by an intrusion of the granite and gneiss and at a still later date by diabase, chiefly in the form of dikes. Niagara limestone, sandstone and conglomerate are found fringing the shore of Lake Timiskaming. Pleistocene clays and sands are also largely developed.

### KEEWATIN.

The group of rocks comprising the Keewatin occurs in several localities. The largest area occupies the whole of the western part of Baby, extending from the Quinze river to the southern end of the township, where it comes in contact with the Pre-Huronian granite. Its eastern limit, as on the south, is marked out by the Laurentian, which occurs two miles east of Long lake. The western border of the area is buried in clay and hence cannot be sharply defined, but isolated exposures occur as far west as the seventh range of Guigues. The northern half of the area just outlined consists of uralitic diabase, diorite and hornblende-schist, while the southern portion is made up of quartz-porphyrite. Other localities in which the Keewatin occurs are north of Rousselet lake, east of Clear lake, the fifth and seventh range of Fabre and the seventh range of Duhamel. In the first two localities the rocks consist of greenstone, hornblende-schist and serpentine, in Fabre township of schist and porphyrite, and in Duhamel of serpentine.

The complex of igneous rocks comprising the Keewatin is thus largely of a metamorphic character. The less altered areas, which consist of uralitic diabase and diorite, change gradually into hornblende-schist and serpentine, the latter probably representing the extreme result of metamorphic action. The quartz-porphyrite, which is intrusive through the other members of the series and is therefore later in age, has not been subjected to such extreme alteration. It consists of phenocrysts of quartz, plagioclase and, less frequently, orthoclase, enclosed in a fine-grained, chloritic ground-mass.

### HURONIAN.

Huronian conglomerate and greywacke occur widely throughout the territory in question, but usually either in small isolated outcrops or in bands of no great thickness at the base of quartzite ridges. The largest area is that found in southern Lavernochere extending from Otter lake to Rousselet lake and southward into Fabre township. The conglomerate consists of a matrix of varying texture enclosing well-rounded fragments of granite, green-schists, diabase, diorite, quartz-porphyrite and other rocks, that variety lying immediately beneath being much the more abundant. When sufficiently exposed the conglomerate is usually found to pass upward into greywacké by the gradual loss of its pebbles and boulders.

The upper member of the series, the equivalent of the rock which Professor Miller has called Lorraine arkose on the Ontario side of the lake, is confined to the succession of hills and ridges bordering the east shore of Lake Timiskaming. The rock is a coarse-textured quartzite passing through all the intermediate modifications to arkose,

the latter being found in those portions resting directly on the Pre-Huronian granite. The quartzite occasionally passes upward into conglomerate by the addition of pebbles and boulders of granite and other rocks. The most typical example of this was observed at the eastern extremity of the road between ranges VI and VII, Fabre township. Pebbles of quartz and jasper occur locally throughout the quartzite. These areas are particularly abundant in the vicinity of Ville Marie. As a rule the quartzite, as well as the underlying conglomerate and greywacké, is but slightly disturbed, the dip rarely exceeding 20°. The transitionary character of the contact between the quartzite aand the underlying members of the series can be seen at three points on the shore of Lake Timiskaming, namely, on the south shore of Lavellee bay, on a point to the south of Joanne bay, and on the bay to the north of Wright's mine. It can also be observed on the slope of the ridge which parallels the 'Quinze' road across range V, Duhamel. No evidence of unconformity was observed in any of these localities.

### GRANITE AND GNEISS.

Two distinct, acid, igneous rocks are found in the region: the first may be termed the Pre-Huronian granite, and the second the Post-Huronian granite and gneiss.

The Pre-Huronian granite (Laurentian), which cuts the Keewatin but antedates the Huronian, occupies the northern part of Laverlochere township and the adjoining portion of Duhamel. It also occurs on the shore of Lake Timiskaming at the south end of Fabre township, and on Baie des Pères.

The rock is a biotite granite, the biotite being present in very small quantities. It is usually very coarse and in the southern part of the Laverlochere area becomes a typical granite-porphyry. The relationship between the granite and the green schist of the Keewatin is well shown on lot 6, ranges IV and V, Laverlochere. At some points the contact is of a transitionary nature but at others it is quite definite, dikes of the granite penetrating the Keewatin. The contact between the quartz-porphyrite and the granite is not sufficiently exposed for their relative ages to be determined. The unconformity between the Huronian arkose and the Pre-Huronian granite is one of the striking geological features of the Quebec side of Lake Timiskaming. The arkose passes by an insensible gradation downward into the granite from which it is derived. Rock-sections from this contact, as found on the lake shore south of Ville Marie, have already been described* by Dr. Barlow. The same relationship on a larger scale was found exposed for a distance of nearly three miles in the northern part of range IV, Duhamel. There is a contact on the shore of Lake Timiskaming opposite Drunken island, in which the granite has been broken down in a similar manner, but the overlying rock is the basal conglomerate. On the other hand the junction between the basal conglomerate and the granite exposed on the lake shore, in lot 18, range I, Fabre, is very definite without any evidence of decomposition of the granite surface.

The Post-Huronian granite and gneiss comprise the whole of the southeastern part of the area mapped. It is probable that the gneiss and part, if not all, of the granite enclosing Lac des Quinze belongs here also, though in the absence of overlying Huronian the two granites cannot be separated. The distinction between the granite and gneiss is very indefinite, all intermediate types being found. The gneiss not only possesses a parallel arrangement of its constituent minerals but is also banded,

*Annual report, G. S. C., vol. x, p. 100.

the alternate bands differing only in the amount of biotite or hornblende present. The biotite gneiss is much the more common. Occasionally the banding is replaced by an irregular arrangement of light and dark granite or gneissoid granite. Basic nuclear segregations frequently occur at these points. The strike of the gneiss approximates a northeasterly direction but local variations are very numerous. The contact between Post-Huronian granite and Huronian greywacké is exposed for a short distance about one mile southwest of Otter lake. The line of junction is very definite with small dikes or stringers cutting the greywacké along the margin of the granite. Elongated patches of conglomerate included within the gneiss were observed to the east of Otter lake. An area of a rather complex rock occurs in the township of Fabre, which possibly represents a marginal basic variation in the Post-Huronian granite and gneiss. The rock has been subjected to considerable dynamic action and is cut by fine-grained granitic dikes, which also cut the granite and gneiss. In the less altered portions it appears to be a coarse diorite. The absence of contacts with nearly all of the neighbouring rocks makes its correlation exceedingly difficult and, until thin sections of the rock have been examined, the writer cannot express a definite opinion as to its age.

### DIABASE.

The Post-Huronian diabase which occurs in the region is chiefly in the form of dikes, the largest of these being that which extends in a northeasterly direction from Otter lake. There are a number of dikes cutting the gneiss in the vicinity of the outlet of Lac des Quinze. One of these extends across the lake as a chain of islands.

### SILURIAN.

Remnants of the Silurian syncline which occupied the northern part of the Timiskaming area occur at numerous points along the east shore of Lake Timiskaming. From Chief island to Piché point a boulder conglomerate occasionally interrupted by quartzite fringes the lake shore. Small patches of an arenaceous limestone slightly inclined to the southwest occur at frequent intervals from Piché point to Faure bay. Detailed descriptions of these outliers have been previously given in various reports on the Niagara of Lake Timiskaming. A small hill of Niagara almost enclosed in drift was observed on lot 18, range II., Guigues. This is a calcareous sandstone dipping 5° to the southwest, without fossil remains.

### PLEISTOCENE.

The Pleistocene of the region consists largely of clay with local surface areas of sand. The clay is distinctly stratified and in the vicinity of the Otter river forms well-marked terraces.

### ECONOMIC GEOLOGY.

No discoveries of economic importance have as yet been made, though a considerable amount of prospecting has been done. Since the silver ores of Ontario are associated with the Post-Huronian diabase, the limited extent of this rock in the area examined greatly reduces the probability of similar discoveries being made. Two iron range areas are known in the Keewatin of the region, one in the neighbourhood of Clear lake and the second crossing the portage from Kakake lake to the Quinze river. In

the Clear Lake area two parallel ranges appear on the surface at varying intervals. They consist of bands of quartz and siliceous magnetite carrying a large amount of iron pyrites. The maximum width of the outcrops is thirty feet. The Kakake iron range consists largely of jaspilite but, like the Clear Lake occurrences, is not of sufficient extent to be of value. Iron pyrites is a usual constituent of the Keewatin green schist and greenstone, and occasionally the mineral is found in small vein-like deposits, conforming to the strike of the schist. These frequently contain a small amount of chalcopyrite but the ore body is not large enough, nor the percentage of copper high enough, to justify mining operations. The diorite of Fabre township appears to be well mineralized, containing chalcopyrite, galena, calcite and other minerals. No large quantities, however, have been located.

# REPORT ON THE DISTRICT ALONG THE NATIONAL TRANSCONTINENTAL RAILWAY FROM BELL RIVER EASTWARD.

*W. J. Wilson.*

The work of the past summer consisted in an examination of the country along the line of the National Transcontinental railway from Bell river eastward to the Susie river near the headwaters of the Gatineau river. A strip, varying in width from five to ten miles north and south of the line, was examined as carefully as time would permit. The principal exploration was done in canoes, following rivers and lakes near the railway line. But there are large areas through which there are no canoe routes and these were examined by traverses through the woods on foot. These traverses were made at intervals sufficiently near each other to give a good general knowledge of the geology and natural resources of the country. It should be clearly understood, however, that in surveying a country which is everywhere forest covered, without roads or other easy means of travelling between the rivers and lakes, it is impossible to examine every hill or rock exposure in detail. To do so would mean that only a comparatively small area could be finished in one summer. The weather the whole summer was unfavourable and much time was lost on account of rain, in which respect the season was exceptional.

Wabanoni lake, which lies west of Obaska lake, was first examined. It was surveyed by compass and micrometer, and a similar survey was made of Migiskan river from the last crossing of the railway line up to the north end of Millie lake, also the Atik, a branch of the Migiskan, including Atik, Couillard and Durant lakes. A track survey was made of the route between Durant lake and the Susie river. This route is through several small lakes and long portages and includes parts of the Kekek and Kapitachuan rivers.

Wabanoni lake is situated about two miles west of Obaska lake. It is surrounded by low shores wooded with spruce, poplar and canoe-birch. Rock exposures are seen along the south shore and the southern part of the east shore and are chiefly diabase. At the extreme south there is a rusty-quartzose rock holding considerable quantities of pyrite.

The southern part of Obaska lake included in the district examined, is bordered by low ground rising gently back and on the west side covered with a dense growth of small spruce and poplar. The rock as mapped by Dr. R. Bell is mostly green schists. These schists continue down the Bell river almost to the final location of the railway line ; north of this, granite and gneiss extend beyond the border of the district to be examined. The country along the south exploration line between the Bell river and the Migiskan is comparatively level, and is covered with a dense forest of spruce and poplar alternating with Banksian pine knolls and black spruce swamps. Near the Bell river, diabase containing numerous quartz veins was the only rock observed. Three miles west of the Migiskan diabase, hornblende-schist and granite were seen.

The Migiskan river rises near the sources of the St. Maurice and Kapitachuan rivers and is about 130 miles long. The last fifty miles of its course is through the

area under consideration, where it is between 500 and 600 feet wide. The last twelve miles are almost a continuous rapid. Above that to Millie lake there are several rapids and short stretches of swift water. Some of the worst rapids had portages cut past them during the present summer. From the north the river receives several branches, of which Sunday creek, Crooked creek and Trout brook are the largest. At its most southerly bend where the railway cache is situated, it receives a stream of considerable size from the south, and six miles farther up the Atik enters from the east. The banks of the Migiskan are usually low, with an occasional hill in the distance. The soil close to the river is mostly alluvium, but in places there are considerable areas of sand. Trees of a good size grow on the richer ground along the river, especially spruce and poplar. In the adjacent country canoe-birch and Banksian pine are common. Opposite the Migiskan cache and less than a mile south of the river there are two large white pine trees (*Pinus strobus*). These were the only white pine seen on the river and seem to mark the present northern limit of the species.

At the first rapid and portage above the railway line the rock is a rather fine-grained reddish-grey granite with a somewhat gneissic structure. Following the river the next outcrop is seen nineteen miles farther up, or nearly two miles below the mouth of the Atik, where there are two small exposures of a dark hornblende-schist which are almost covered by water. There is, however, an outcrop of similar rock on either side of the stream flowing into the Migiskan opposite the railway cache. On the west side these rocks are well seen in a low hill about a mile and a half south of the Migiskan, and on the east side in a hill about three-quarters of a mile. In this hill the rock is a greenish schist containing small grains of calcite holding pyrite. There are at the same place quartz veins six inches thick but as far as examined they hold no mineral of economic importance. Above the mouth of the Atik on the Migiskan the next rock occurs a short distance below Trout creek and is a gneissoid-granite. The same rock is seen on the portage into Millie lake. This portage is through a recently burnt Banksian pine plain and is over a mile and a half long.

Millie lake is an expansion of the Migiskan river and is from a mile to a mile and a half wide for nine miles when it narrows to less than a quarter of a mile and continues narrow as far as it was surveyed,—about three miles. The shores are mostly hilly and at the northeast end present some perpendicular cliffs. All the rock observed on this lake was gneissoid-granite or gneiss and the same rock was seen eastward along the trail line up Smoky creek and on Cedar creek and adjacent hills.

Along the railway line between the crossings of the Migiskan river granite and gneiss are the common rock. Crooked creek, which enters the Migiskan a mile and a half below the railway cache, was ascended and was roughly surveyed. It is thirty to forty feet wide and has low banks mostly clay and sand covered. As the stream is ascended the country for some distance back becomes hilly with several isolated, rounded peaks, composed of gneissoid-granite much broken up. At the railway line there is a Banksian pine plain with large areas of muskeg to the west. Seven or eight miles north of the railway line up Crooked creek there are numerous dikes or masses of diabase through the granite and the country is hilly and broken. Some hills rise 500 feet or 600 feet above the railway line or 1,600 feet above sea level.

The Atik river was examined and surveyed to the north end of Durant lake, a distance of fifty-four miles. For the first twenty-three miles, or up to Hill portage

the river forms a very good canoe-route, but above that there are numerous rapids up which the canoes had to be pulled by hand, or taken over a portage cut. Nearly all the rapids can be run with partly loaded canoes. The adjacent country is generally sandy and covered with Banksian pine. Large areas of the forest along this river were destroyed by fire in 1906. Well foliated gneiss is abundant and becomes garnetiferous at the Atik cache, forty-five miles from the mouth of the river, and continues increasingly so to the east as far as examined. In some of the hills it is metamorphosed and much altered.

Along the rivers, lakes and portages from Durant lake to the Susie river there is little change in the country, forest or rocks. Garnetiferous gneiss, well foliated and striking in a general way east and west is seen in frequent exposures, while sand plains covered with a small growth of Banksian pine prevail. There are, however, large areas well wooded with spruce, poplar and canoe-birch. Much of this country has also suffered greatly from recent fires.

The rocks observed in the western part of the district are green schist and diabase which seem to grade into each other without any sharp line of separation, they probably belong to the Keewatin. All the eastern part of the area is underlain by granite and gneiss with small dike-like masses of diabase. The granite and gneiss are Laurentian while the diabase is probably post-Laurentian.

There are some areas along the streams and also on the spruce and poplar slopes away from the streams which are fit for cultivation, but the district as a whole is not an agricultural country. The general level along the railway line is from 1,100 feet to 1,450 feet above sea level, with hills several hundred feet higher.

Mr. Arthur J. Merrill accompanied me as assistant and rendered me valuable aid.

I wish to acknowledge my indebtedness to the engineers, transport officers and cache keepers of the National Transcontinental railway who assisted me in every way possible.

# EXPLORATIONS ALONG THE NATIONAL TRANSCONTINENTAL RAILWAY LOCATION FROM LA TUQUE WESTWARD.

*O. O'Sullivan.*

According to instructions, I left Ottawa on May 16, to explore the country along the location of the National Transcontinental railway from La Tuque on the St. Maurice river westward to meet Mr. Wilson's party coming eastward from Bell river. Mr. H. W. Wood was my assistant for the season. The railway line follows the St. Maurice river to Waymontachingue, a distance of 72 miles, and then continues in a northwesterly direction for a distance of 85 miles to the crossing of the west branch of the Gatineau river, which we followed down on our return trip. The country from La Tuque to Coocoocache, a distance of 39 miles by the location, is very rough and hilly with sand plains and swamps between the hills. There are two good water-powers in this stretch. The La Tuque falls and rapids can develop 50,000 horse-power. The other power is at the Iroquois falls on the Vermilion river, a branch of the St. Maurice which is crossed by the railway line at 18 miles from La Tuque. From Coocoocache to Waymontachingue, a distance of 35 miles, the gneiss and granite hills rise sharply from the river and are high and rolling.

Forest fires have done much damage, principally on the west side, but there are still some large areas of good spruce. The soil is generally sandy or swampy except in the valleys of the large streams entering the St. Maurice river; there we found a rich loamy soil. Several good water-powers can be had in this last stretch.

From Waymontachiingue we ascended the Ribbon river, which flows into the Manuan river about two miles west of Waymontachingue. This river takes its source from Lake Kamistgamak, about 28 miles in a northwesterly direction from Waymontachingue. It is a small stream flowing through a valley of from half a mile to three miles wide, with sand plains covered with moss and scattered growth of jackpine.

Leaving Kamistgamak a portage was made into the waters of the Gatineau river. By following a small crooked creek for three miles we entered Lake Menjobagus which is the largest sheet of water in the vicinity, measuring about eight miles long by one mile wide on an average. The country to the south is high rolling and well wooded with black spruce, birch, poplar and balsam.

From Menjobagus we descended the waters flowing to the east branch of the Gatineau river to Jack-pine creek, a distance of sixteen miles ; then followed up the creek to its source twelve miles west, and made a portage into the St. Maurice waters again. From this point the country to the south is well wooded with black spruce. Some white pine were seen on the east branch of the Gatineau.

From the source of the Jack-pine a portage of about a half a mile in length brought us to the East Cache creek, then by following down this small stream we reached Ascalaneo lake which forms part of a system of waters having many large

lakes drained by the St. Maurice river. From this lake half a day's travelling took us to the west branch of the Gatineau river.

The rocks throughout the whole country which we explored are gneisses, granites and schists. The gneisses strike east and west and the small areas of schists strike in the same direction, both rocks dipping at various angles. The gneisses, especially in the western part of the country explored, contain large numbers of small crystals of garnet.

No economic minerals were found except some iron sands which have been handed to the chemist of the Mines Branch for assay.

SESSIONAL PAPER No. 26

# SURFACE GEOLOGY OF THE ST. LAWRENCE VALLEY.

*R. Chalmers*

The field work carried out by me during the season of 1907 was practically a continuation of that of former years in the St. Lawrence valley, in the region extending from the Notre Dame mountains on the south to the Laurentides on the north, and from eastern Ontario and Lake Champlain on the west to the Gulf of St. Lawrence. The work was also extended to the slopes bordering the valley, more particularly to those on the south side.

I left Ottawa on June 12, proceeding to Sherbrooke, which was made our headquarters for about two months. My assistants in the field were Messrs. E. G. McMahon and R. M. Chalmers, two college students, both of whom rendered me good service, and besides doing other work, levelled the heights of a large number of the marine shore lines from the lower St. Lawrence westward to the United States boundary and the province of Ontario.

In 1905-6-7 a series of observations was carried on by the writer in southeastern Quebec, and measurements were made of the altitudes of the shore lines referred to. These are described in a report published in 1898*. The results then at hand were, however, fragmentary, but at subsequent intervals other facts have been added. Before this season most of the altitudes had been measured with aneroid barometers only, and consequently were more or less inaccurate, but during the past summer my two assistants levelled, with spirit level and rod, the whole series from Rimouski westward to the International boundary near Lake Champlain. Very full and, it is hoped, accurate results have been thus obtained. Photographs of a number of these shore lines have also been taken.

The observations made thus far indicate an undulating or wavy line or lines in profile throughout the whole St. Lawrence valley from the Gaspé coast westward, with a general rise in the same direction. A series of three of these shore lines usually occurs, the lowest being the most perfect, the middle one tolerably continuous and ths uppermost broken and denuded, and in some places almost entirely obliterated. These three are generally found together above the margin of the marine plain, which may, perhaps, also be called a shore line. Ascending the slope from the margin of this plain we observe the first and second of the shore lines referred to in apparently a horizontal attitude wherever the physical conditions have been favourable for their formation. These are almost always in a good state of preservation and can be followed for miles. The third or highest is the one which we everywhere levelled, as it denoted the maximum height of the uplift, though the two lower ones have also been measured in order to ascertain their deformation from a horizontal attitude. Taken together the three, in all cases, show deformation, and as pointed out in the report cited, with an increasing uplift westward till we reach the central part of the Eastern Townships. The

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*Report on the Surface Geology and Auriferous Deposits of Southern Quebec, Geol Surv. of Can., Vol. X (new series), 1898.

highest point they attain appears to be in Wolfe and Richmond counties. West of this they descend gradually and are much broken up before reaching the International boundary. No attempt has been made to trace them beyond Canadian territory; but Baron DeGeer, a Swedish geologist, when in America in 1891 measured the altitude of a shore line in the vicinity of St. Albans, Vt., and found it to be 658 feet above sea level.

A considerable amount of work was also done in tracing the shore lines on the north side of the St. Lawrence valley. Here they are much more irregular and broken than on the south side, so much so that in many places it is very difficult to trace them continuously or even to identify them. The lowest shore lines are, of course, best preserved, the upper ones show great deformations, and in many places are entirely worn away by denudation. This fact would seem to indicate greater oscillation than on the other side of the valley. A tolerably full series of altitudes has been obtained, however, from the Saguenay river westward to Ottawa. Owing to my assistants having to leave me in September, and to other causes, observations are not as complete on this side of the valley as on the other side.

The changes of level referred to in connexion with these shore lines must have taken place about the close of the Pleistocene period or during the movements of the land which raised the Leda clay and Saxicava sand beds above sea level. The deposits constituting the shore lines are chiefly sand and gravel, similar to those of the Saxicava sand beds, and are doubtless of the same age.

A report, map and profile of these shore lines is in course of preparation.

## THE MARINE PLAIN OF THE ST. LAWRENCE VALLEY.

The plain of the St. Lawrence valley which exhibits everywhere a comparatively uniform surface, with low undulations and protruding crystalline hills, does not everywhere retain the same contours as its rocky floor beneath. Stripped of the covering of surface deposits, the inequalities would be found to be greatly accentuated and valleys and basins would appear where now these deposits have levelled them off to an apparently horizontal plain. There is, however, a gradual rise from the St. Lawrence river outwards towards the mountains on both sides of the valley, besides an increase in altitude as we proceed up river from east to west. Filled-in ancient river valleys which existed before the present ones were eroded are found in places, and some of the inequalities in the rock surface of the valley must have been produced before the glacial period, as boulder-clay occurs everywhere in the depression beneath Leda clay and Saxicava sand.

The limits of the marine area designated the St. Lawrence valley were traced on the map during the past season with greater accuracy than had hitherto been attempted, and the character and distribution of the marine beds were studied in detail. As the inequalities of the surface of the plain referred to likewise affect the borders and slopes on either side, to a greater or less extent, and these are consequently seldom regular or horizontal for long distances, the border of the plain is often interrupted or broken. Atmospheric denudation has also played an important part as regards the evolution of these topographic forms.

GLACIATION.

The glaciation of the region, though carefully studied in 1895-98, was further examined at a number of critical points, especially on the south side of the valley, and it was found that the published work in the report referred to is substantially correct. The southern and southeastern limits of the Eastern Townships and the Notre Dame mountains were carefully examined for evidences of glaciation, but no new data were obtained necessitating a change of view from the conclusions set forth in the published work. It was found that at only a few places did ice from the Laurentides cross the International boundary, and then only in the passes at altitudes not exceeding 1,600 to 1,800 feet.

Abundant traces of the movements of the earlier Appalachian or northward-flowing glaciers were observed. In the townships of Shefford, Brome, &c., however, well marked striæ affording evidence of a westward movement were noted. The ice which produced them was probably a part of the Appalachian system. The same westward courses were seen in several places north of the International boundary between Brome lake and Lake Champlain.

Wherever traces of Appalachian and Laurentian glaciers are found together the accompanying boulder-clay falls into a corresponding two-fold division; that produced by the former is always the underlying, and contains only boulder from local rocks. The overlying boulder-clay of the latter glacier on the other hand contains a considerable proportion of material derived from rocks belonging to the north side of the St. Lawrence, i.e., from the Laurentide hills, and is found overlapping the older beds as far south as the Notre Dame mountains, and is, in the western part, carried farther south through the gaps and passes of the hills along the boundary line.

7-8 EDWARD VII., A. 1908

# THE SERPENTINE BELT OF THE EASTERN TOWNSHIPS.

*John A. Dresser.*

In the month of April, I received instructions from the Director of the Geological Survey to begin an examination of the serpentine and allied rocks in southern Quebec, with a special reference to their economic products—asbestus, chromic iron, copper, talc, antimony, &c. This work was begun on May 3. The serpentines and peridotites are known to extend with more or less continuity from the Vermont boundary line to Gaspé. But for purposes of a detailed examination it was found necessary to begin with the portion of this area that should afford the best facilities for a thorough investigation. Accordingly, after a preliminary reconnaissance of the southern part of the field, it seemed best to concentrate the first season's work in the mining district of Thetford Mines and Black Lake, where the deposits of asbestus and chromic iron could be best observed, and also where many of the rock structures which are essential to a complete investigation, are well known. Thus, between May 3 and August 2, my time was spent in an examination of the serpentine belt, between D'Israeli and East Broughton, an area of thirty miles in length, and from five to eight in breadth. In this time about eighty mines, prospects and mineral occurrences were examined, as well as the natural rock exposures of the whole area. During the months of June and July I had the assistance of Mr. Alex. Maclean, senior student in geology, Toronto University, and of Mr. R. Randall Rose, student in the Faculty of Applied Science, in the same institution. Both of these gentlemen proved throughout capable workers and careful observers, and were indefatigable in their efforts to make their work efficient. I must also acknowledge with thanks many courtesies received from the owners and managers of the various mines in the district.

## GEOLOGY.

The rocks of the serpentine, or peridotite, belt in this district form an intricate complex. The oldest rocks are a series of slates that were at first mistaken for highly altered sediments, but careful study in the field and examination of several thin sections under the microscope show them to be altered volcanic rocks having the general composition of porphyrite. It is possible that there are altered sediments amongst them, but this has not yet been certainly established. Through these there has been intruded the serpentine-peridotite which contains the asbestus, chromic iron and talc of the district. Associated with the latter are the granites, whose relation to the serpentine in point of age, seems, in some places, to have been contemporaneous, while in others they are of later formation. Besides these rocks there are large bodies of diabase of yet later age. This rock is especially characterized by strings and nodules of epidote. It contains the pyrrhotite-chalcopyrite deposits of Garthby and Lake Clapham, in this district, as well as those of Bolton and Potton, farther to the south. This diabase cuts sediments of Trenton age at Mount Orford, and thus indicates a comparatively late period of intrusion. In crossing this igneous belt, four separate bands of breccia are found, the largest of which is a quarter of a mile in width. The

matrix is a volcanic rock of medium basicity, either porphyrite or an acid diabase. It contains abundant fragments of all the other rocks of the district, and appears within the diabase or peridotite, or between diabase and Cambro-Silurian sediments.

All the rocks of the district have been much deformed by regional metamorphism, and hence have been intruded before the completion of the Appalachian uplift, or previous to Permo-Carboniferous time.

The principal part of the investigation of these rocks was applied to the ore deposits, which can only be treated in an extended report. In general it may be said that the chromite occurs largely as a primary segregation from the original magma, and was thus the first mineral of this rock series to be formed. The asbestus, on the other hand, has been the last or latest mineral to be formed. It seems to have resulted from the alteration of bands of peridotite, rich in olivine, in which the metamorphism has been farthest advanced. The peridotite mass has been reduced to serpentine with the exception of 5 to 10 per cent of pyroxene, but along joint planes and fracture crevices the alteration to serpentine has become complete, and in its final stage the asbestus has been deposited within these joint or fracture crevices. To describe these occurrences in detail, however, further investigation, and an extended report, are necessary.

## SURVEYS IN SOUTHERN NEW BRUNSWICK.

*Dr. R. W. Ells.*

The changes made during the summer of 1906 in the geological position of the Perry sandstone formation, through the finding of Devonian plants in these beds on Kennebecasis island and elsewhere, by which they were transferred from the Lower Carboniferous to the underlying formation or system, necessitated a revision of the geological formations included in the Devonian and Lower Carboniferous, from Lepreau on the west, to the eastern shores of Westmorland county. During the past season this has been nearly completed, and such separation of the red conglomerates and shales of the lower part of the Perry and the grey fossiliferous sandstones and shales of the upper portion, from the limestone, gypsum and other sediments of the Lower Carboniferous has been made as closely as possible. These changes include a considerable portion of the province south of the Kennebecasis valley and the line of the Intercolonial railway between St. John and Sackville.

In addition some time was spent in more closely outlining the areas of Cambrian rocks to the east of St. John city.

Among other changes which have thus been made in the geology along the north side of the Bay of Fundy is the transference of considerable areas of shales, conglomerates and sandstone, extending from the vicinity of Black river to Melvin beach, about seven miles east of St. Martin. On the published map these were in part assigned to the horizon of the Millstone-grit, and in part to the Lower Carboniferous; while to the north and east of St. Martin the areas so coloured were found to belong in large part to the Triassic. Thus the conglomerates of McCoy head, east of Black river, were recognized as a part of the Perry conglomerates, beneath which in the direction of Gardiner creek they were underlaid by a series of red and grey shales and sandstones that are apparently continuous downward and should fill a gap which on the east side of St. John harbour appears to occur between the Perry outlier of that place and the underlying Mispeck formation. Some portions of the grey beds along this shore contain plant stems which will require careful study later. Most of these sediments are highly inclined, showing the presence of faults and folds. In this work I was assisted by Dr. G. F. Matthew, of St. John.

Thence, continuing the work eastward to St. Martin, similar rocks were observed at many places, both along the coast and inland, till the old rocks of the coastal range were met, the upper grey beds containing fossils similar to those found in the grey beds of Kennebecasis island, where they directly overlie the red Perry beds.

At St. Martin the Triassic formation was greatly extended. The soft red sandstones and pebble conglomerates of the shore were found to be overlaid by a series of reddish beds having a uniform northerly dip for nearly two miles. This dip is reversed to the south shortly before reaching the older mountain rocks. In places, the Triassic sometimes rests upon the grey beds of the Devonian, and the presence of a well defined syncline is recognized. Plant stems were occasionally seen, but no collections of these were made.

Farther east, on the shore of Albert county, as at Point Wolf, and at Owls head, east of Alma village, the rocks are in part red conglomerate of the Perry formation. They here form a syncline in which the grey plant-bearing beds are well seen, and upon these are small unconformable outcrops of generally reddish Lower Carboniferous sediments with which are associated areas of gypsum. In the grey portion of the Perry at this place is a great abundance of plant remains which should furnish excellent material for the collector. The Perry rocks as a rule are highly inclined, and in places contain fossil tree trunks.

At Cape Enragé the red and grey beds of the Perry are also well exposed. The grey beds abound in plant remains, and the strata are generally highly inclined, in places reaching the vertical. The underlying beds are mostly red marls which lie between the grey and the coarse red conglomerate of the Perry. The central part of this basin around Germantown lakes shows an unconformably overlying series of Lower Carboniferous conglomerate with marly shales, which in places hold small deposits of gypsum. The Devonian rocks occupy most of the area between the Pre-Cambrian hills to the north and the shores of the Bay of Fundy, and eastward they extend to Grindstone island and Mary point, where large quarries in grey and brown sandstone were at one time worked extensively. Most of the rocks in this area between the bay and the mountain range to the north, are somewhat sharply folded. East of Albert village the Devonian rocks continue along the flank of the Caledonia mountain to Shepody mountain, and it is possible that the conglomerate of the latter represents a large outlier of the Perry conglomerate, since in no part of the recognized Lower Carboniferous have any such masses of these conglomerates been observed. Along its southern flank also there are several outcrops of limestone and gypsum with red shales of the overlying formation.

Crossing the mouth of the Petitcodiac river to Cape Maringouin the red marls and grey sandstone of the Upper Devonian again appear with high dips, and are overlaid unconformably by deposits of gypsum at what is known as Pink ledge, on the west side of the peninsula. Similar beds appear farther north on the roads to Sackville and Dorchester, occasionally with nearly vertical dips. These are sometimes overlaid by grey sandstone of Millstone-grit age, and sometimes by sediments belonging to the Upper Carboniferous formation.

The series of bituminous sediments usually known as the 'Albert shales' extends through Albert and eastern Westmorland and is a portion of the Upper Devonian, resting in places on the red beds of the Perry, and affected by the same disturbance that is seen generally throughout the Upper Devonian of this area.

Along the valley of the Kennebecasis bay and river the Perry conglomerates and upper shales are continuous from Kennebecasis island past Hampton to beyond Sussex. South of this place, along the valley of Trout creek, as far as the mountains south of Waterford village, the hills of Dutch valley are for the most part made up of overlying Lower Carboniferous sandstone and conglomerate, beneath which occasional anticlines of the Devonian outcrop along the river valleys. In this area the Albert shales are seen at a number of points, and they have been traced almost continuously from a point a couple of miles north of Hampton village into Westmorland county, though occasionally concealed by the overlying Lower Carboniferous beds.

In addition to the areas thus described, several outliers which rest upon Pre-

Cambrian rocks and were formerly regarded as of Lower Carboniferous age were examined, and were also found to be of Perry age.

To the west of St. John city the geology of Pisarinco peninsula was revised. It was found that Devonian beds from the base of the Bloomsbury to the Mispeck are represented, and that the formation is much more extensive than was at one time supposed. These sediments are broken up, and in places highly altered by intrusive masses of diabase and rhyolite. Much of the Devonian in this district as well as east of St. John is highly altered, the shales assuming the aspect of schists and the Dadoxylon sandstone becoming a true quartzite.

In Carleton county certain areas of reddish conglomerate with grey sandstone and shale, which appear to the north of Woodstock and thence extend across the St. John river south of Hartland, were re-examined, and were found to belong to the Perry formation, the grey beds of the upper portion being also fossiliferous. It is also possible that a portion of the large Tobique outlier may belong to the Perry, but time and weather conditions did not permit of a close examination of this area.

The general outlines of the Cambrian rocks were not materially altered from those laid down on the published geological map of southern New Brunswick. In several places the lowest division of this system, known as the Etcheminian, was indicated, but the formation is too thin to be correctly delineated except on a large scale map. The areas best defined are those known as Division 2, which is in places highly fossiliferous, consisting of greyish and dark shales with quartzite bands. Division 3 is seen chiefly in the southern part of St. John city. The determination of the fossils obtained from the several divisions has been made by Dr. G. F. Matthew, and the results have been published in the Transactions of the Royal Society of Canada from time to time, as well as elsewhere.

SESSIONAL PAPER No. 26

# THE TIN-BEARING LOCALITY AT NEW ROSS, N.S.

*G. A. Young.*

The field-work of the past season was devoted to an attempt to form some general conception of the igneous, geological history of New Brunswick and Nova Scotia. Though the results obtained are not available for immediate publication, considerable material for study was accumulated. Numerous traverses, largely over igneous rocks, were made in the two provinces, more particularly along the shores of Chaleur bay, through the Shepody mountains and in the vicinity of St. John city, in New Brunswick; across the Cobequid hills and near Arisaig, in Nova Scotia, and in the northeastern part of Cape Breton.

A brief visit while accompanying Mr. R. A. A. Johnston, of this staff, was paid to the locality of the reported discovery of tin ore in Nova Scotia, near New Ross, about sixteen miles inland from Mahone bay, on the Atlantic seaboard. The results of a very short examination seemed to indicate that the cassiterite occurs as an accessory constituent in a pegmatitic mass within a body of light-coloured, medium-grained muscovite granite. At the point of discovery a pit twenty feet deep had been sunk in the pegmatite, but when visited was filled with water. A certain amount of stripping in the immediate neighbourhood had failed to disclose further outcrops of the tin-bearing body, which seems to be of the nature of an irregular, acid schlieren, closely connected in origin with the containing muscovite granite. The pegmatite mass varies in grain, and in places is very coarse, with large quartz crystals at times a foot or more long, and embedded in kaolin or decomposed feldspar. Various boron- and fluorine-bearing minerals and others containing rarer elements have been recovered from the pegmatite and surrounding granite. The amount of tin present does not appear to have been accurately determined, and is doubtless small.

The light-coloured muscovite granite with which the cassiterite-bearing pegmatite is associated, was seen at a number of points in the neighbourhood and appears to be cutting a coarser-grained, biotite granite like the variety that throughout the eastern portion of Nova Scotia penetrates the gold-bearing sedimentary series. The more common biotite granite is usually rich in the dark mica and frequently is porphyritic with large crystals of feldspar often an inch in length.

In the neighbourhood of New Ross, various pegmatitic bodies, areas of fluorite-bearing granite, &c., have been reported and are possibly connected with the muscovite granite. From information obtained it seems probable that the muscovite granite with which the tin occurs at New Ross, or a similar rock, is rather widely distributed through the granitic regions of eastern Nova Scotia. It is thus possible that in some places they may be found to be tin-bearing, probably as at the original locality, in coarse-grained veins and irregular bodies.

## LUNENBURG COUNTY, NOVA SCOTIA.

*E. Rodolphe Faribault.*

Mr. Faribault was engaged at headquarters from October 10, 1906, until June 19, 1907, when he left for Nova Scotia to resume his work in the field; he returned to Ottawa on October 12, 1907.

### *Office Work.*

While in the office he completed for publication the manuscript covering the map-sheets of Prospect, Halifax City, Waverley, Elmsdale, Windsor, Ponhook Lake, St. Margaret Bay and Tancock Island. The Prospect and Elmsdale sheets have since been published and the others are in course of publication. A new feature brought out on these sheets is the marking in feet above sea-level of elevations of land, lakes and water-falls, which will certainly be appreciated and should prove useful, especially in estimating the water-powers available in the vicinity of Halifax, Windsor and the several mining camps of that region.

A special plan of the Brookfield gold district, on the scale of 250 feet to one inch, was also completed and is now being engraved. The plan of Malaga gold district has been published. These two plans complete the publication of 26 plans of the most important gold districts of the province which will be included in a general report on the gold fields, to be issued this coming year.

Mr. Faribault was assisted in the office part of the time by Mr. F. O'Farrell in the compilation of the inch-mile manuscript map from the surveys made a few years ago. The compilation has now been carried as far west as the Halifax and Southwestern railway, along La Have river, and north to the old Annapolis road, and it is hoped that by next spring the office work will have caught up to the field work. These maps are of immediate importance to the province, and their publication is now being pressed forward.

### *Field Work.*

Of the field work accomplished in Nova Scotia during the summer of 1907, Mr. Faribault reports as follows:—

My instructions for the past summer's work were to complete the structural geology of the gold-bearing rocks extending along the coast from Chester to Bridgewater, and to make a special examination of the mineralized dikes of the New Ross granite region, where tin ore and other valuable minerals have recently been discovered, in order to prepare for publication the New Ross, Chester Grant and Mahone Bay map sheets. The last two sheets were completed but the New Ross sheet could not be, on account of the exceptionally wet weather experienced the greater part of the time, as well as the complicated nature of the structure of the gold-bearing rocks and the scarcity of the rock exposures, necessitating many more exploratory surveys to get the necessary data.

In accordance with instructions received, I left Ottawa with Mr. F. O'Farrell on June 19, 1907, for Mahone Bay, Nova Scotia, where I was joined by my two other assistants Messrs. J. McG. Cruickshank and D. S. McIntosh, B.A.Sc. Mr. McIntosh had already preceded me by going to New Ross three weeks earlier to observe and help if possible, in the developments being made on the John Reeves' tin deposit.

Mr. O'Farrell was engaged the greater part of the summer in making the surveys and taking the levels, with the transit and stadia, of 160 miles of railways and main roads which are to be used as control lines to lay down the surveys already made in Lunenburg and Queens counties, and to work out the elevations of hills, valleys, lakes and water-falls.

### *Carboniferous Limestone and Gypsum.*

The field work consisted principally in completing the revision of the structural geology of the gold-bearing rocks lying along the Atlantic coast from Chester to Bridgewater and extending inland to the granite boundary, and in mapping out a succession of narrow deposits of limestone and gypsum of Lower Carboniferous age stretching out irregularly along the shore and over some inner islands, from Chester basin to Mahone bay.

A heavy mantle of glacial drift covers a great part of the rocks along the shore and for a certain distance inland, so much so, that gypsum was seen only in one place, on the southwest shore of Goat island, and the shell limestone could be observed only on Goat, Sheep and Stephen islands. The presence of these deposits in that locality was totally ignored by the inhabitants of the place, and may prove a source of profit now that they have been made known. They can be made out, however, by the symmetrical and circular, inverted, funnel-shape pot-holes, often attaining twenty feet in depth, which indicate the presence of gypsum, and by the irregular, hummocky, broken ground and the peculiar dark and luxuriant vegetation which characterize the limestone deposits.

Bits of bituminous coal handed to me were reported to have been found at Barkhouse mill and The Narrows, in Lower Carboniferous areas. A few prospecting pits were sunk at these places to depths of twenty to sixty feet, but without reaching bed rock. It is quite possible that small seams of coal might occur in that formation, as they have been found in many other localities in similar rocks in Nova Scotia, but it is very doubtful if they would be of sufficient thickness to be of economic importance. Moreover, it is not certain that the coal was carried there by natural agency.

### *Gold-bearing Rocks.*

On account of the close and intimate relation existing between the occurrence of the gold-bearing veins and the anticlinal folds, it is of the greatest practical importance that the structure of the anticlines and synclines, the dislocations and faults, should be well defined on the map sheets and sections, in order to help and encourage intelligent research in new districts where rich gold float has been found, and also to guide in the development of mines that are in operation. In view of the economic and scientific importance of the structural geology great pains were devoted to it. In many cases to arrive at a satisfactory solution the same locality had to be repeatedly examined and surveyed, especially along the shore, in the vicinity of Mahone bay, where the rocks are concealed by extensive accumulations of glacial drift and the exposures are scarce. The difficulty is still increased by a strong development of the slaty cleavage which is sometimes so much pronounced as to obscure and often obliterate the planes of stratification. I have much pleasure in acknowledging that the successful carrying out of this work is in no small measure due to the energy and zeal displayed by my assistant, Mr. Cruickshank.

The gold-bearing rocks of the region examined have been forced into a succession of folds, almost parallel to each other, bearing a general northeasterly and southwesterly course. A detailed description of the structure of these folds and the faults affecting them could not be followed intelligently unless accompanied by a map and would be too lengthy for this report; it must, therefore, be deferred until a complete report is published with the maps.

The greatest width of the gold-bearing rocks in the area examined, measured at right angles to the folding, is forty miles along a straight line drawn from Cross island at the entrance of Lunenburg bay, to Dalhousie road. A cross-section made along that line would give eleven major anticlines and as many synclines, and a few other minor folds. Of the eleven anticlines, five are in the slate or upper division of the gold-bearing series which are generally not gold-producing, and six have brought up to the surface the quartzite ('whin') of the lower gold-producing division of the gold-bearing rocks. In the area under study four gold districts have been opened on four distinct anticlines; they are Spondo, Blockhouse, Indian Path and The Ovens, and of these Blockhouse has been by far the most productive. Detailed reports on these districts must be deferred until the surveys are all plotted and compiled.

At Centry, often wrongly called Centre, several large blocks of quartz sprinkled with gold have been found the last few years between Dares lake and the main road leading from Lunenburg to Bridgewater, three miles out from the former town, and much prospecting has been done to find the vein *in situ*, but until now without success. There is very little doubt that this float comes from the anticline passing immediately north of Dares lake, where the quartzites of the lower division have been brought up on a broad elliptical dome, three miles long by one mile wide, which is completely surrounded and overlaid by the slates of the upper division, and exhibits a structure very similar to that of the Caribou gold district. Much prospecting was done by Walter H. Prest to the north of the float, on the south limb of the quartzite dome, and several interbedded veins were discovered, but no gold was found in the veins or the drift, showing that the gold-bearing vein is further south. It will probably be found to occur in the slate, near its contact with the quartzite, where the maximum amount of movement and fissuring should have taken place, and it may cut the stratification at a slight angle, like the famous Lake lode, which was worked at Caribou to a vertical depth of over one thousand feet.

An examination was also made of the places where gold was reported to have been found, and in nearly every case they proved to be on, or in close proximity to, an anticline. The knowledge acquired in the study of the geological structure of the region often led to useful and practical information regarding the mineral deposits visited and, wherever possible, this was furnished on the spot directly to those entitled to it. In this manner much benefit is often derived from the work accomplished in the field which is not made public, for the results may not possess general interest and perhaps do not appear in the reports.

### *New Ross Tin Deposits.*

The boundary line between the gold-bearing rocks and the granite was carefully traced from Goat lake, on the shore of Mahone bay, to Dalhousie road. As stated above, it was found impossible to complete this summer the revision of the granite area extending to the north. On account, however, of the importance of the recent discovery

of tin ore and other valuable minerals in the granite at New Ross, a few days were spent in the examination of these deposits. This being the first discovery of tin ore in anything like economic quantities made *in situ* in Canada, it might be opportune to record it here in detail.

As early as 1868 tin is reported by Professor How to have been found at Tangier by W. Barnes, in a sand composed of quartz and decomposed feldspar, and Dr. E. Gilpin also obtained it in panning gold in the same locality. It was also reported at Shelburne, by J. Campbell, at Rawdon, by Harry Piers, and at Country Harbour and Malaga. Such finds were all connected with drift material.

In 1903, the writer surveyed geologically the New Ross region and reported in the Summary Report for that year the occurrence of pegmatite dikes bearing minerals of economic value, and recommended the locality as a promising field for prospecting.

In the Summary Report for 1906, a reference is again made to the ore-bearing character of the granites of that region, and to a report that tin ore had been found by Charles Keddy, at Lake Ramsay. But this find could not be verified, as samples brought then from that locality and examined for tin proved to be only minute crystals of zinc blende.

Mr. Harry Piers, curator of the Provincial Museum, accompanied by Mr. M. H. McLeod, visited the locality in November, 1903, and reports (Report, Dept. of Mines, Nova Scotia, 1906, p. 91) that the presence of pieces of quartz crystals, on the surface, led John Reeves, the owner of the land, and Benjamin Meister, to dig a small pit in wood land a short distance southwestward of Mr. Reeves' house; the site of the pit being about three-eighths of a mile south of the Dalhousie road, and three miles west of New Ross, Lunenburg county, N.S. In digging this pit, kaolin and large crystals of quartz were encountered, with which was associated some purplish-black fluorite.

Charles Keddy, of Lake Ramsay, who had been prospecting for tin ore in that neighbourhood for some years, in examining Mr. Reeves' prospect, found a dark mineral which he brought to Halifax in the middle of October, and this, on examination, proved to be cassiterite, the tin oxide. The property was thereupon taken up on October 22, under licence to search, by John Reeves, Benjamin Meister, Charles Keddy and E. E. Bishop.

Last winter samples of ore from the Reeves' prospect were received at different times by the Survey, and upon examination by Mr. Johnston they proved to contain, besides cassiterite, scheelite and wolframite, two valuable ores of tungsten, also amblygonite, an ore of lithium new to Canada, and other less important minerals.

Early last spring M. J. O'Brien and Neil A. King acquired an interest in the property and the latter took charge of the development work.

On the first of June, my assistant, Mr. McIntosh, was sent to New Ross, where he remained three weeks to observe the development, and to examine and collect samples while the shaft was being sunk. The New Ross deposits were again visited in August by the writer, in September by Mr. McIntosh, in October by Mr. R. A. A. Johnston, and in November by Mr. Johnston and Dr. Young. The material taken out was thus closely examined by officers of the Survey as the development progressed; a large number of specimens were collected and sent to the laboratory of the mineralogist for determination, and the operators were kept informed as to the nature and value of the ore extracted. Mr. Johnston has not yet completed his laboratory work, but his

report will be published shortly and should prove very valuable to those interested, as several of the minerals discovered may prove of even more economic value and importance than cassiterite. From the results of Mr. Johnston's determinations up to date, the following minerals have been found to occur in the granites at New Ross: cassiterite, monazite, one of the columbite minerals, durangite, amblygonite, a lithium mica probably lepidolite, wolframite, scheelite, hubnerite, molybdenite, zinc blende, beryl, apatite, tourmaline, fluorite, pyrolusite, manganite, limonite, hematite, magnetite, siderite, bismuthinite, argentiferous galena, copper, iron and arsenical pyrites, kaolin and fire-clay, crystals of black smoky quartz, large crystals of white, smoky quartz, some of which measured twenty-seven inches long by ten inches thick. It may be remarked that, of these minerals, amblygonite and durangite are new to Canada; monazite and columbite are ores of rare metals used in the manufacture of the Nerst electric lamps; lepidolite and amblygonite are valuable ores of lithium; wolframite, scheelite and hubnerite are the three ores of tungsten used to harden steel; molybdenite and bismuthinite are also used in certain alloys; and clear, unflawed beryl crystals are precious stones.

At the time of my visit, on August 7, the King pit on the Reeves' tin deposit was eighteen feet deep, and measured twelve feet long by ten feet wide. The deposit is a pegmatitic segregation in the ordinary light grey granite of that region. It is composed of crystalline masses of feldspar enclosing very large crystals of smoky quartz with a little mica and other associated minerals, included in the list given above. The feldspar constitutes the greater part of the dike. The large quartz crystals, the fluorite, the tin ore and other associated minerals occur chiefly in zones about the middle of the dike, in feldspar generally much decomposed. There is no well defined foot or hanging wall. The strike of the dike is N. 65° E., and the dip is to the northwest and varies from 75° at the surface to 60° at the bottom of the pit. At the outcrop the dike was about eight feet in width and twelve feet in length, but the development shows that at one end at least it extends farther to the northeast under a cap of granite. The deposit appears to be what is often called by miners a 'blow-out.' It is probably the result of deep solfataric action and it should extend to a great depth. The results obtained so far should be considered very satisfactory and they warrant much greater development.

It may be interesting to know that two miles north of the tin discovery a small area of quartzites and slates of the gold-bearing rocks occurs followed farther east by a much larger area, both of which are all surrounded with granite. Gold has been found in quartz veins in these rocks.

The tin discovery has led to a good deal of prospecting in the vicinity of New Ross, with the result that several pegmatite, porphyry, aplite and quartz dikes bearing economic minerals have been discovered. Specimens from some of these collected last summer or sent directly to the Survey's laboratory, proved upon examination by Mr. Johnston to contain valuable minerals, which have been included in the list given above.

Traces of tin ore were identified in a few small specimens taken from a pegmatitic dike, twenty-four feet thick, discovered a mile north of Nevertell lake, on a tributary of Gold river, six miles south of Reeves' tin discovery.

Bismuthinite and molybdenite were found in a dike of quartz and aplite, one mile south of New Ross corner.

Ores of tungsten and rare earths were discovered on Dr. Lavers' and Frank

Boylen's claims, in a dike of pegmatite, twenty feet wide, situated one mile east of New Ross corner.

Reference has already been made in a previous report to the occurrence of a vein of molybdenite on Larder river, one and one-half miles southeast of Reeves' tin discovery, and to sphalerite and fluorite, on Lake Ramsay; and the manganese mine at Wallaback lake, some five miles northward of New Ross, is well known.

# THE LARDEAU DISTRICT, BRITISH COLUMBIA.

*R. W. Brock.*

The instructions for the past season were to proceed to the Lardeau district and complete the work necessary for the publication of a map of the strip of country adjacent to the Columbia and Lardeau valleys from Revelstoke to Kootenay lake. Similar work had been completed, in 1904, as far as Poplar creek, so that the surveys to be accomplished this season lay between that point and Kootenay lake. This work being finished, the balance of the season was to be spent in Rossland to complete the study of that camp. Mr. Boyd, who, as in previous years, was associated with me as topographer of the party, was further instructed to start topographical work in the Similkameen district where field work was being prosecuted by Mr. Camsell of this Department.

Concerning his work, Mr. Boyd reports as follows:—

'I left Ottawa on June 4, for the Lardeau district, and was joined at Brandon by Mr. Shirley King, my assistant for the season.

'The first two weeks in the field were spent in occupying camera stations on some of the lower ridges and in selecting a suitable locality for the measurement of a base line to check the triangulation of the district, brought down from a base at Revelstoke, eighty miles distant. After the work in the Lardeau was fairly started, I left on June 21 for the Similkameen, returning, after starting the topography there, to the Lardeau on July 1.

'The topographical work in the Lardeau was carried on by the photographic method, and although the season, especially during the months of August and September, was very unfavourable for work on account of the almost continuous rain, yet enough information was obtained to map the strip of country lying between Poplar creek and the north end of Kootenay lake. This strip, which has an average width of about twenty miles, is an extension, in a southeasterly direction, of the country mapped during the seasons of 1903-4.

'The triangulation was carried down Kootenay lake to Kaslo in order to connect with the West Kootenay map sheet.

'The work in the Lardeau was brought to a close on September 19, owing to the unfavourable weather conditions. The remainder of the season until October 4 was spent in Rossland completing the work on the 1,200-foot map of that area, after which I left for Ottawa.'

During the months of June and part of July I was on leave of absence in northern Ontario. I joined Mr. Boyd at Poplar creek the first week in August. After looking over some of the claims about Poplar we proceeded to examine the basin of Cooper creek, after which we carried the survey down Kootenay lake to Kaslo. We were joined on September 3 by Dr. Low, and went with him up the Duncan river to Haleys. From Haleys, after Dr. Low's return, we proceeded to Hall creek, but weather conditions continued so unfavourable that it was considered advisable to remove to Rossland, having obtained enough information to proceed with the publication of the

Lardeau map. The work at Rossland was completed by October 4, and I returned east.

The country explored this season, like all the Lardeau, is extremely rugged. The mountains are lofty, some of them, as Cooper mountain and that at the head of Hamill creek, exceeding 10,000 feet in elevation. They are usually studded with glaciers and snow-fields. The streams entering the head of Kootenay lake and the Lardeau and Duncan are rapid torrents, debouching from picturesque canyons, even in the rapidly disintegrating phyllites. Frequently they have their sources in glacier-fed tarns.

Some of the cirques are cut in stratified rocks whose beds are of varying hardness. The result is a ridged cirque, the parallel lines of ridges traversing the cirque marking the strike of the rocks which in most cases happens to be across the cirques.

The northern faces of the mountains are usually precipitous ; the southern, being exposed to the sun and consequent temperature changes, more frequently have slopes corresponding to the angle of rest of the disintegrated fragments.

A frequent phenomenon on these slopes is the snow 'moraines.' These are usually crescentric mounds about five feet high, of small rock fragments and soil, which seem to form at the foot of snowbanks. All but the higher peaks show strong evidences of glaciation.

Land suitable for ranching occurs in the Lardeau and Duncan valleys, but only a limited acreage is as yet under cultivation.

Timber suitable for local purposes is to be found almost everywhere except, of course, at the higher elevations. Up the Duncan valley fine timber occurs, a number of companies have secured timber berths and preparations for lumbering operations are being made.

The high altitude tamarack, a comparatively rare tree, is abundant in this district about timber-line.

The geology of Poplar creek was described in the Summary Report for 1904. Very little development work has been done here since that time, so that it has not yet been satisfactorily demonstrated whether there is pay ore in this camp or not. Some rich, but so far small, pockets of gold-bearing material have been found.

On the Hecla claim on Rapid creek a shaft forty feet deep has been sunk on a quartz vein which has a width of about six feet at the bottom of the shaft. The quartz is rusty, with decomposing siderite. A tunnel, which was in about 253 feet at the time of our visit (September 9), had not intercepted the vein. Later in the season rich samples of auriferous quartz were found on a claim south of Poplar creek.

The arsenopyrite-bearing country rock which in places at least is auriferous, has not yet been systematically prospected, so there is still a possibility that somewhere it may be found to be of pay grade.

The rocks south of Poplar were also described in a general way in the Summary Report for 1904. They consist of a sedimentary series made up of slates, limestones and quartzites usually somewhat metamorphosed, invaded by dikes of gabbro, metamorphosed to greenstone-schists. At a few points more recent basic dikes are seen cutting these formations. Still younger granite intrusions break through and greatly disturb and metamorphose those older formations, sending out dikes of aplite and pegmatite between the beds and across the formations. Where highly altered, the sedimentary rocks and older intrusives become micaceous, chloritic, garnetiferous and calcareous schists, crystalline limestone or marble, micaceous quartzite, &c.

Just at the head of Kootenay lake the rocks form a low anticlinal arch with a slight plunge northward. The almost horizontal dip in the centre of the valley rapidly changes to steeper angles on the limits of the anticline on either side, and in a short distance from the valley becomes highly inclined, overturned, squeezed into tight S folds and faulted. On the Cooper Creek slope the prevailing dip will be, therefore, westward; on the Hamill Creek slope, eastward.

The sedimentary series, with included greenstone schists, and, especially near the head of the creek, granite dikes, extends to the head of Cooper creek where the granite massive, which forms the divide between the Lardeau and Columbia river, is encountered. Approaching the granite the sedimentary rocks are much contorted, crinkled on both a large and a small scale, and frequently faulted. Quartz is developed, especially as bedded veins and often in the saddles or inserted saddles of rock folds.

On the Great Britain claim at the head of the south fork of Meadow creek and at the north branch of Cooper creek, a considerable amount of work has been done, one tunnel having a length of 300 feet run in to prospect quartz 'veins' exposed on the cliff a short distance above the tunnel mouth. Some good ore has been obtained from the 'veins'—grey copper in kidneys in a quartz gangue.

The relationship of the quartz to the rocks is suggestive of a saddle reef, but complications are introduced by faulting, so that following the ore is difficult. On the opposite side of the gulch another tunnel has been run in 150 feet to develop a quartz lead mineralized with pyrite, siderite and sericite. Above this tunnel on the summit of the hill, bedded veinlets of quartz are abundant in the phyllites.

Up the south branch of Cooper creek, above the second forks, is an outcrop of acid granite strikingly porous (miarolitic). The sedimentary rocks invaded by this granite include some black limestone bands, some of which are altered to white marble, and some are beautifully interbanded with fine slaty layers.

A little farther up the south branch, on the west slope of the valley, is the Copper Cliff group of claims, on which some work was being done. On the sides of a little gulch the exposed rocks are rust-covered from decomposing sulphides. The country rocks consist of greenstone and banded sedimentary rocks, which are upturned to an almost vertical position, with intruded sheets or dikes of granite-porphyry. Some of these are about, if not quite, parallel to the strike of the sedimentary rocks. (If they have been intruded between the strata they should be called sheets, but as it is not certain that this is the case, for any great distance, the commoner term dike may be employed). Near the dikes, and parallel to the strike of the rocks, are several bands of ore. One band, about two feet wide, is exposed on the trail to the main exposure. The second, on which a crosscut tunnel was being run, has a width of three feet, then a horse of dike was run through, with ore again on the other side. The face of the tunnel was still in ore, several feet beyond the dike. Across the gulch, near a little canyon, a couple more small bands of ore were exposed. The ore, which could not be traced for any great distance up the mountain (and below its outcrops the slopes are wash covered), seems to be confined to the neighbourhood of the dikes. It consists of pyrrhotite, chalcopyrite, often interbanded with the pyrrhotite, a little zinc-blende, with, in places, a considerable amount of calcite gangue. Most of the gangue is, however, silicified rock (jasperoid) and biotite-schist. On the north side of the canyon some pyroxene-like mineral is also developed in the gangue.

The ore is said to run low in gold but to carry some silver; the main value is in the copper, which, however, is variable.

The work done was insufficient to enable an opinion to be formed as to the percentage of copper the ore was likely to carry and the amount of ore that might be developed. The deposit is interesting, being a unique type in the Lardeau, where practically all the known lodes are either auriferous or silver-lead quartz deposits, in which chalcopyrite is inconspicuous and tetrahedrite is the only abundant copper-bearing mineral. The Copper Cliff ore, on the other hand, is more like some of the ores in the southern part of West Kootenay, such as the Rossland camp. This resemblance consists not only in the association and dominance of pyrrhotite and chalcopyrite, but in the biotitization and silicification of the associated country rock.

The main difference between this and the other Lardeau deposits, outside the ores, is the number of granite-porphyry dikes occurring here and the metamorphism of the sedimentary rocks adjacent to them. There is a strong probability of a genetic relationship between those dikes and the ore deposits.

The rocks of the Duncan river to Hall creek are phyllites, hornblende and mica schists and gneisses, with a few limestone and quartzite bands.

The rocks up Hall creek are somewhat similar but less metamorphosed. A heavy band of quartzite several hundred feet thick constricts the creek into a canyon. Above this to the 'lime dike,' near the head of Hall creek, the rocks are graphitic phyllites, with occasional bands of limestone and green chloritic schists. Small quartz veins cut these rocks in an intricate way and silicify them in the neighbourhood of the veins.

The Bannockburn claim on the south side of Hall creek, just below the 'lime dike,' was once worked, but has been neglected the last few years. The work consists of numerous open cuts along a vein exposed on a rock bench, and a tunnel run in to crosscut this vein from below. The vein can be traced for several hundred feet and seems to occupy the contact between a rusty, thinly fissile schist (west wall) and a limestone band (east wall). It varies greatly in width from a mere streak to, at one point, several feet of solid ore. The ore consists of galena, zinc blende and chalcopyrite, weathered on the surface to rusty oxides and carbonates. The tunnel has been driven in ninety feet to a silicified and slightly mineralized band of rock which has been followed about one hundred feet, without encountering any ore. It is doubtful if this tunnel has been driven far enough, as a crosscut, to catch the vein, and there is as yet no proof that the vein is only superficial.

In this part of the country where the rocks are so badly folded and the veins show a tendency to be bedded (i.e. conform to the bedding planes of the rock) it is very risky undertaking expensive work to crosscut them at depth, without first having followed them down, and thus accurately determined their position. On account of its topographical character most of the work so far done in this part of the country consists of crosscut tunnels that have rarely encountered the veins. So that although there are some good surface showings, it is in most cases still uncertain whether they extend downwards, and if they do, whether the values hold.

Some work was being done on the Wagner claim, mostly in the nature of preparations for serious exploration. This prospect was described in the Summary Report for 1904. The tunnel is now said to be in 100 feet with a forty-foot crosscut. From the tunnel a winze sixty-five feet deep has been sunk and from the winze a

twenty-foot crosscut has been run. The upper crosscut is said to have encountered an eight-foot ledge which in the lower crosscut is said to have widened to ten feet.

The property was being closed down for the winter at the time of our work on Hall creek, and as it had been examined in 1904, and was now snow-covered, it was not revisited.

On the Red Elephant claim, on the north side of Hall creek, near Porcupine flat, is a ledge of siliceous material holding pyrite and chalcopyrite, which crosses the strike of the graphitic phyllite country rock, in a northeasterly direction. A band of limestone occurs just east of the workings. The ledge, on which a couple of small tunnels were being run, has a width of about ten feet. The sulphides are oxidized and leached out on the surface, leaving the pitted, honeycombed quartz. This material, on panning, shows very minute colours of gold and is said, by the prospectors working the claim, to assay $20 to $30 a ton in gold.

There are a number of claims up the Duncan river, but very little development work is being done. The natural difficulties, due to the rugged nature of the country and the lack of transportation facilities, make such work arduous and expensive. Now that lumbering is to be started in this valley it will be made more accessible, which no doubt will result in increased attention to this district on the part of prospectors.

Hamill creek enters the Duncan river from the east, a little above the head of Kootenay lake, through a picturesque narrow box canyon, one of the finest in this part of the country.

The grade built in 1899 by the Great Northern Railway from Argenta on Kootenay lake to Howser lake is used as a wagon road, and from it a wagon road about three miles long has been built at considerable expense through the Hamill Creek canyon to the concentrator of the Argenta mines. The fine rock section exposed on the walls of the canyon is thus easily accessible.

Small landslips have blocked the road in places so that it can now be used only by saddle and pack horses, and unless it is looked after will soon be impassable even for pedestrians.

From the Argenta concentrator a trail extends to the head of Hamill creek across the divide and down Toby creek to a wagon road into the Windermere district.

### ROCKS OF HAMILL CREEK.

Along the Duncan the rocks are schists with a low easterly dip. In the canyon the first rock exposure is limestone, and black argillites with interbanded aplite sheets. The altitude of the beds has become more steeply inclined to the east; crystalline limestone, slates, phyllites, with occasional green chlorite-schists and quartzites are the principal rocks seen in this section. Some of the lime bands are very heavy, but the thickness of the individual rock members is much exaggerated by the crumpling and folding which becomes pronounced a short distance up the canyon. Above the Argenta concentrator a band of quartzite seventy-five feet or more thick is exposed, and beyond this the rocks are more metamorphosed, being of pronounced schists, of which one studded with garnets is abundant.

The Argenta mine is situated on the north flank of the gorge of Hamill creek just above the canyon, about 1,500 feet above the level of the creek. There are two veins on the property of this company, the Clinton vein which strikes N. 10° W., with

a dip of 55° west, and the Mabel-Nora vein striking about N. 8° W., 450 to 500 feet east of the Clinton vein.

The Clinton is a quartz vein carrying chalcopyrite, some gold, and silver to the extent of about one ounce of silver to each per cent of copper present in the ore. The vein occurs in a fissured zone about ten to twenty-five feet in width, with a well marked slickensided hanging wall. The shattered material of this zone forms the ledge material, in which the ore, generally about one foot in width, though widening to two and a half feet, is developed, more frequently probably along the foot wall of the fissured zone. The Mabel-Nora vein is a silver lead vein. The country rocks are limestone phyllites and chlorite schist. Most of the work has been done on the Clinton vein.

No. 1 tunnel starts from a small gulch as a crosscut to strike the ledge, which was encountered in about forty feet and then drifted on. No. 2 tunnel, about 100 feet below, also starts as a crosscut from the gulch and taps the ledge at 150 feet, which is then drifted on for several hundred feet. A rise from No. 2 tunnel has been put through on an ore shoot to No. 1 tunnel and the surface.

No. 4 tunnel about 250 feet below No. 2, and 1,500 feet in length, is the longest in the mine. It is driven one thousand feet along the hanging wall slip and then turns as a diagonal crosscut for the Mabel-Nora vein.

No. 6 tunnel is a short one, also on the hanging wall slip.

Nos. 3 and 5 are mere open cuts.

No satisfactory ore bodies have been located below No. 2 tunnel.

In the creek bottom below the mine, the compressor plant is located. It is operated by water-power, furnished by a flume, half a mile long, supplied by water from Hamill creek, with a small wing dam at the intake. It discharges its water under a 115-foot head to a Pelton wheel, directly connected to the shaft of a one-half 10-drill Canadian Rand compressor.

The mine was not being operated at the time of visit, having been shut down early in the summer. The manager, Mr. Garde, was still in charge of the property.

No ore can be shipped until a tram connects the mine with the wagon road, and it is doubtful if this will be installed unless a greater tonnage of ore is developed.

### ROSSLAND.

Among the more important developments in this camp during the year may be mentioned the sinking of the LeRoi and Centre Star shafts to deeper levels, the Centre Star bottom level (14th) having an elevation of 1,932 feet, about 1,750 vertically below the collar of the shaft, or little more than 500 feet above the Columbia at Trail. The 11th level of the Centre Star has been extensively developed and gives promise of being about the best level in the mine. The 12th level has not been as promising, but it is not yet thoroughly prospected. The 13th and 14th are still in an embryonic stage.

The Iron Mask and Idaho claims have been taken over by the Consolidated Mining and Smelting Company and are being developed largely from War Eagle and Centre Star workings. A shaft is also being sunk on the Idaho. While not very far advanced in development, and while, as in all the mines, ore is not always where it might have been expected, or hoped for, some good ore has been encountered.

A number of dikes and faults converge about the line between the War Eagle

and Iron Mask, and as several veins are present, the result is rather a perplexing number of vein sections, and it is as yet impossible to say just how many or what veins are represented.

The War Eagle is now being operated largely from the Centre Star shaft, electric locomotives being used underground for haulage. Some new ore bodies of good grade have been located in this mine as a result of the development work.

The large new Nordburg hoist and the other improvements at the Centre Star headworks, mentioned in last year's Summary, have been installed and are working satisfactorily.

On both the LeRoi and LeRoi No. 2, the continued development work has demonstrated greater regularity and continuity in the veins and ore bodies than the earlier work suggested.

West of the Josie dike, in the Black Bear workings of the LeRoi, the extension of the biotite rich porphyritic monzonite has been encountered. This rock is exposed on the Red Mountain Railway in a cut just west of the Josie ore veins. It is certain that it does not extend northward far above the track either on the surface, nor, in all probability, underground. Its southern limit is not known, the surface being wash-covered and no underground workings or drill holes having entered this area. But, from its abrupt northern termination and its contacts with the ordinary country rock, the probability is that it may have the form of a plug, intrusive in the country rock, rather than that of an extended dike. On the west side of this mass, the White Bear Mining Company have located a body of ore about twelve feet wide consisting of almost solid pyrrhotite and chalcopyrite running one to one and a half per cent copper and two to three dollars in gold per ton.

Some work is being done on the Spitzer, under bond to the LeRoi mine, and diamond drilling has been undertaken to prospect the ground between the Spitzer and the LeRoi, which was recommended in last year's Summary Report as promising ground for exploration.

Work has been resumed on the California and Giant, the most important line of development being the sinking of a shaft from the old California tunnel to pierce the overlying stratified rocks and from which the (presumably) underlying porphyrite may be prospected for the continuation of lodes developed in the adjoining LeRoi No. 2 mine, whose workings in porphyrite extend beyond the surface contact of the porphyrite and stratified rocks.

Work was also being started on the Jumbo, and several of the smaller properties were having some work done on them by lessees.

Scarcity of fuel and coke in the early part of the year, a scarcity of labour, an advance in wages and then the sharp drop in the price of copper, have all contributed to retard production, which will probably show a falling off as compared with last year. It is unfortunate that while the prices of metals were high, the production had to be restricted.

At the time of writing a despatch from Rossland states that the Miners' Union has voluntarily consented to a reduction of wages, to the scale obtaining prior to July 1, which, it is expected, will cause some improvement in the situation.

# THE CHEMICAL LABORATORY.

*F. G. Wait.*

Conformably with the practice of former years, the work performed in the chemical laboratory during the twelve months ending November 30, 1907, has been confined almost entirely to the examination or analysis of such minerals, ores, &c., as were thought might prove of economic importance.

The specimens brought in during the year totalled 1,075, being an increase of 300 over the number examined in the preceding twelve months. They have, taken collectively, been of the usual widely varying character, but may, for present purposes, be conveniently classed as follows:—

1. Different varieties of fossil fuel from:
   - (*a*) Nova Scotia—The Richmond mine, Cape Breton county.
   - (*b*) Alberta—
     - i. Sec. 16, tp. 6, R. 30; W. of 4th meridian.
     - ii. Sec. 9, tp. 17, R. 17; W. of 4th meridian.
     - iii. Sec. 30, tp. 38, R. 23; W. of 4th meridian.
     - iv. Sec. 28, tp. 15, R. 27; W. of 4th meridian.
     - v. Bow river, at a point some twenty miles south of Brooks station, C.P.R.
     - vi. Cascade basin, six samples.
     - vii. Costigan basin, three samples.
     - viii. Scalp Creek area.
     - ix. South Brazeau river, eight samples.
     - x. Prairie creek, two samples.
     - xi. Bighorn river, three samples.
   - (*c*) British Columbia—
     - i. Morice river, Skeena district, four samples.
   - (*d*) Yukon—
     - i. Coal creek, Sour Dough mine.
     - ii. Lewes river—
       - (*a*) Five Fingers mine, two samples.
       - (*b*) Tantalus butte, three samples.
2. Iron ores from:
   - (*a*) Nova Scotia—
     - i. Limonite from Indian harbour and from Caledonia, Guysboro' county.
     - ii. Hematite from Ben Eoin, Bras d'Or lake, Cape Breton county and from Black river, Richmond county.
   - (*b*) New Brunswick—
     - i. Hematite from near Dorchester, Westmorland county.

(*c*) Quebec—

i. Hematite from L. 1, R. 3, of tp. of Dunham, Missisquoi county.

ii. Magnetite from Big Pipestone rapid, Quinze river.

(*d*) Ontario—

i. Hematite, from township of Somerville, Victoria county.

ii. Magnetite from a point ten miles west of Savanne lake, Thunder Bay district.

iii. Limonite, ten samples, from townships of Oakley and Draper, Muskoka district.

(*e*) Manitoba—

i. Hematite and limonite from near Deepdale, just west of Roblin, along the line of the Canadian Northern railway.

(*f*) Saskatchewan—

i. Clay iron-stone from Pas mountain.

(*g*) Alberta—

i. Clay iron-stone from:

(*a*) Bow river, just west of Knee hill.

(*b*) Red Deer river, two miles north of Brooks.

(*c*) Two miles north of Burnus siding.

3. Iron sand, from:

(*a*) Quebec—Rouge river, Buckingham township, Labelle county.

(*b*) British Columbia—from the Fraser river, at:

i. Big Bar.

ii. Little Big Bar.

iii. Lillooet bridge.

iv. Alexander creek, a tributary of the Fraser.

4. Copper ores, from:

(*a*) New Brunswick, Albert county.

(*b*) Quebec—

i. Bonaventure county, Matapedia township.

ii. Drummond county, Lot 21 of township of Wickham.

(*c*) British Columbia—

i. Highland valley, Kamloops div.

ii. Mud creek, a tributary of the Chilcotin river.

5. Antimony ore, from near Whitehorse, Yukon.

6. Nickeliferous pyrrhotite from:

(*a*) Quebec, Pontiac county.

(*b*) Ontario—

i. Nipissing district, townships of Craig, Moncrieff and Springer.

ii. Renfrew county, township of Pakenham.

iii. Victoria county, township of Somerville.

7. Limestones and Dolomites from:

(*a*) Nova Scotia, Dorton bridge, rear of Port Hastings, Inverness county.

(*b*) Quebec, township of Rawdon.

(*c*) Ontario, Lot 6, Con. IV., Stormont township, Stormont county.

8. Calcareous Marls from:
   (*a*) New Brunswick, Restigouche county, Martin lake.
   (*b*) Quebec, Wright county, township of Cantley.
   (*c*) Ontario, Huron county, township of Morris.
   (*d*) Manitoba, vicinity of Dauphin.
   (*e*) Alberta, vicinity of Didsbury.
9. Brick and pottery clays from:
   (*a*) Nova Scotia—
      i. Cape Breton county, near junction of Meadows and Morley roads, in the vicinity of Woodbine post office.
      ii. Guysboro' county, Lower Salmon river.
   (*b*) New Brunswick—
      i. Flower cove, Grand lake.
      ii. Rothwell Coal Company's property.
      iii. Westmorland county, vicinity of Salisbury.
   (*c*) Ontario—
      i. Carleton county, Lot 17, Con. III., of March.
      ii. Stormont county, Lot 10, Con. VI., of Stormont.
   (*d*) Saskatchewan—
      i. Town of Vonda.
      ii. Six miles above Medicine Hat, on bank of Saskatchewan river.
      iii. Sec. 28, tp. 36, R. 7, W. of 3rd.
   (*e*) Alberta—
      i. Vicinity of Wetaskiwin.
      ii. Vicinity of Gleichen.
      iii. Sec. 25, tp. 25, R. 3, W. of 5th.
   (*f*) British Columbia—
      i. Vicinity of Ashcroft.
      ii. Minto mining district.
10. Natural water from :
   (*a*) Quebec—
      i. Wright county, R. 4 of West Templeton.
      ii. Wright county, Lot 6, R. 8, of Eardley.
      iii. Wright county, near Breckenridge station, Eardley township.
   (*b*) Ontario—
      i. Russell county, Lot 22, Con. X., of Clarence—nine samples.
      ii. Timagami mineral spring.
   (*c*) Saskatchewan—
      i. Carrot river, three miles above Sipanok channel.
11. Gold and silver assays, from the provinces of :
      i. Nova Scotia.
      ii. New Brunswick.
      iii. Quebec.
      iv. Ontario.
      v. Saskatchewan.
      vi. British Columbia.
      vii. Yukon.

12. Miscellaneous examinations :

i. Infusorial earth, from Glen Morrison, Cape Breton county, N.S.

ii. Calcareous tufa, from Kelowna, B.C.

iii. Phosphatic shale, from Chimney Corner, Inverness county, N.S.

iv. Tar sand and mineral tar, from several localities in Alberta and Saskatchewan.

v. Carbonaceous shale, from the vicinity of Springhill and New Glasgow, N.S.

vi. Iron ochre, from Torbolton, Carleton county, Ont.

vii. Silt, from east side of L. Winnipeg, opposite Elk island.

Of all the specimens examined, only a comparatively small number have been thought worthy of mention in the foregoing list, the remainder having been of particular interest to the individual owner only, to whom the necessary information was imparted at the time of calling, or by letter. Letters written number 496.

The laboratory was under the direction of Dr. G. C. Hoffman until his retirement from active service on April 1, 1907. Since that date I have been in charge, and have been ably assisted by Mr. F. Connor, B. Ap. Sc.

Acting upon instructions from Dr. Low, I spent a portion of the months of May and June in visiting the laboratories of Harvard College; the Institute of Technology in Boston; Columbia School of Mines, New York; the U. S. Mint, and the University of Pennsylvania, at Philadelphia; the U.S. Geological Survey at Washington; and the Lackawanna Steel Company at Buffalo. The object desired was to become acquainted with the methods and appliances employed at these larger institutions, with the view of the adoption of such as might prove advantageous in this laboratory. I was received everywhere with the utmost courtesy and was given every opportunity, not only of becoming personally acquainted with many of the foremost workers in this class of investigation, but also of observing and noting whatever appeared to be worthy.

REPORT ON WORK DONE BY M. F. CONNOR, 1906-1907.

| Ores. | Gold and Silver. | Copper. | Lead. | Zinc. | Nickel and Cobalt. | Antimony. | Platinum. | Tin. | Iron ores. | Limestones. | Coals. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of determinations.. | 398 | 17 | 8 | 3 | 5 | 7 | 9 | 1 | 17 | 12 | Seven coals approx. analyses and calorific determinations. |
| No. of samples .. .. .. | 200 | 17 | 8 | 3 | 3 | 7 | 9 | | | | |

Of the above eighty samples for gold and silver, seven antimony ores determinations are referred to in Mr. Wait's statement.

Assays of gold and silver ores were made on samples from Ontario; from Cobalt, Larder lake, Algoma, North Bay, Sudbury and Timagami district.

From Chibougamau, Pontiac county, Quebec.

From Brookfield, Middle river, Cape Breton.

From Skeena river, Omineca district, Fraser river and Yukon in the west.

Assays of copper ores from Lake Bennett (Yukon Territory), Lorraine township, Whitefish lake, Chibougamau, Cox-Heath and Cape Breton.

Antimony ores from Yukon Territory.

Iron ores (Bog), Muskoka, Ont., Pontiac, Que., and Alberta.

Coals, British Columbia and Alberta.

A considerable number of rocks of much interest and importance have been received for analysis from geologists of the Survey.

Arrangements are being made for carrying out such work, and a beginning has been made, rocks having been analysed for Dr. Adams, Dr. Daly and Dr. Dresser.

## SECTION OF MINERALOGY.

*Robt. A. A. Johnston.*

The work in this section has been largely of a preliminary character; in the early part of the year, with the co-operation of Dr. G. A. Young, a short descriptive pamphlet was prepared to accompany the High School collections of 1907; the determination to make some radical improvements in the collections for High Schools and Collegiate Institutes necessitated a careful revision of the lists of species and localities as well as the elimination of a quantity of material which in the nature of things had been accumulated in past years and which had been found unsuitable for the purpose in view; the ever increasing popularity of these collections has not only made this attention necessary but imperative.

As will be seen from the subjoined lists a large amount of new material has been assembled during the past season; a few desirable species are, however, still unrepresented; in most instances this is due to the remoteness of or difficulties of access to the localities where suitable materials are to be found in sufficient abundance; these will receive special attention during the season of 1908, by the end of which it is hoped that the Department will be in a position to issue collections of Canadian minerals in every way creditable to it and highly suited to the educational needs of the institutions for which they are intended.

During the year a large amount of determinative work has been carried out; in addition to the determinations incident to the sorting over of material already in the Department eighty-six consignments have been received from persons in different parts ot the country involving the examination of some four hundred separate specimens; the number of letters received was 89 and the number sent out was 84.

A Stoe Reflexion-Goniometer has been added to the equipment.

The following mineral species are now for the first time recorded as occurring in Canada:—

*Amblygonite, a fluo-phosphate of aluminum and lithium,* from King's 'tin-lode' near Lake Ramsay, Lunenburg county, Nova Scotia; *durangite, a fluo-arsenate of aluminum and sodium,* from the same locality as the preceding species; *argyropyrite, a sulphide of silver and iron with a small amount of copper,* from the Foster mine, Cobalt, Ontario. A few others are still the subject of investigation.

My field work for the year was confined to a brief excursion, October 7-16, to the new mineral localities in the parish of New Ross, Lunenburg county, Nova Scotia, and to the antimony mines near Lake George in the parish of Prince William, York county, New Brunswick, from both of which places a number of interesting specimens were collected for examination.

Mr. R. L. Broadbent, who had been engaged with the Dominion Exhibition Commission at work at Foreign and Colonial Expositions, returned to duty in the Department in July, since which time in addition to discharging a large amount of Museum work he has been engaged in collecting minerals at a number of the more important localities in Northern and Central Ontario; Mr. C. W. Willimott superintended the

assembling and labelling of the High School collections, and during the summer visited a number of localities in the Gatineau valley; Mr. A. T. McKinnon assisted in arranging and despatching the High School collections, and during the summer has collected a large amount of material from various points in Nova Scotia, Quebec and Eastern Ontario; the reports of these gentlemen are herewith appended.

The additions to the Museum consist as follows:—

*Donations.*

Per Dr. R. W. Ells—

Albert Manufacturing Company, Hillsborough, N.B.; Hon. C. J. Osman, Manager:—Albertite with gypsum.

James Robinson, Albert Mines, N.B.:—Albertite from Albert Mines, Albert county, N.B.

Cobbler-Sexton Mining Company, Woodstock, N.B.; J. Draper, Secretary:—Native gold in quartz, from parish of Northampton, Carleton county, N.B.

Per R. L. Broadbent—

Nipissing Mining Company, Cobalt, Ontario; T. R. Drummond, General Manager:—Native silver, native bismuth, niccolite, smaltite and cobalt ore showing arborescent markings.

O'Brien Mining Company, Cobalt, Ontario; T. Culbert, General Manager:—Native bismuth, argentite, chloanthite, breithauptite.

Buffalo Mining Company, Cobalt, Ontario; T. R. Jones, General Manager:—Argentite and native silver.

Black Donald Mining Company, Calabogie, Ontario; H. F. Meech, Manager:—Graphite, both in massive and in crystal forms.

T. Morrison, Bancroft, Ontario:—Sodalite, nephelite and apatite crystals from Dungannon, Ontario.

W. S. Morden and A. C. McLatchie, Belleville, Ontario:—Barytocelestite from Loughborough, Ontario.

Per Dr. H. M. Ami—

M. McLeod, Ottawa, Ontario:—Cleaved crystal of pyroxene from the township of Arundel, Argenteuil county, Quebec.

Per A. T. McKinnon—

W. G. Fairbairn, North Wakefield, Quebec:—Large twin crystal of pyroxene from township of Wakefield.

Dr. A. E. Barlow, Ottawa, Ontario:

Stromeyrite, argyropyrite and native silver in calcite from the Foster mine, Cobalt, Ontario; native gold in quartz from Mining Location T.R. 169, Nipissing district, Ontario; freibergite in quartz from the Silver Queen mine, Cobalt, Ontario; molybdenite and chalcopyrite from the Dreany Location, seventy-six and a half miles from North Bay, Timiskaming and Northern Ontario Railway; chalcopyrite from Mining Locations on Timber Limits 137 and 138, north of Massey, Algoma district, Ontario; massive specimen of chalcopyrite and niccolite from Hubert lake, Montreal river, Nipissing district, Ontario; hematite (specular iron) from west side of Silver lake, an expansion of the same river; native bismuth from the O'Brien mine, Cobalt, district of Nipissing, Ontario; pentlandite from Krean Hill mine, Denison tp., Ontario.

J. Obalski, Quebec:

Section of Chambord meteorite.

Charles Boylan, New Ross, N.S.:

Crystallized native copper with chabazite from Cape d'Or, Cumberland county, N.S.

Joseph Martin, Plantaganet, Ontario:

Calcite with rod of iron-pyrites.

H. A. Cameron, Ottawa:

Sphene with scapolite, from the township of Dorion, Wright county, Que.

Rev. G. Eifrig, Ottawa:

Five nodular concretions from near High Falls post office, Villeneuve, Labelle county, province Quebec.

Henry A. Rudin, Halifax, N.S.:

Manjak from Vistabella mines, Trinidad, B.W.I.

*Exchanges.*

E. Monaco, Portici, Italy:

Sal ammoniac, halite and volcanic ash, all products of the eruption of Vesuvius in 1906.

*Collection by Officers of the Department.*

Dr. A. P. Low:

Stromeyrite, argyropyrite and native silver from the Foster mine, Cobalt, Ontario.

E. R. Faribault:

Quartz crystals and amblygonite from Lake Ramsay, New Ross, Lunenburg county, N.S.

Charles Camsell:

Portion of silicified tree-trunk from Agate hill, B.C.

R. L. Broadbent:

Green fluorite with barite, calcite (Iceland spar), calcite crystals, hematite with stilpnomelane, from Madoc, Ontario; barytocelestite, from Loughborough, Ontario; nephelite crystals from Dungannon, Ontario.

*Purchases.*

Two specimens of native silver from Nova Scotia Mining Company, Cobalt, Ontario.

Massive specimen of silver-nickel ore from the Right-of-Way mine, Cobalt, Ontario.

The following educational institutions in Canada have been supplied with collections during the year. Unless otherwise noted the full 1907 collection of 145 specimens has been supplied:—

Province of Alberta—

High Schools:—Lethbridge; Medicine Hat.

Province of British Columbia—

High Schools:—Armstrong; Revelstoke; Vancouver; Victoria.

Province of Manitoba—

High Schools:—Carberry; Neepawa; Souris.

Other institutions:—St. Mary's Academy, Winnipeg.

Province of New Brunswick—

High School:—Moncton.

Province of Nova Scotia—

Academy :—Guysboro' (27 specimens).

Other institutions:—St. Ann's College, Digby.

Province of Ontario—

Collegiate Institutes:—Barrie; Guelph; Lindsay; Napanee; Perth; Renfrew; St. Thomas; Toronto Junction (9 specimens).

High Schools:—Arthur; Aylmer; Chesley; Eganville; Elora; Gravenhurst; Harriston; Hawkesbury; Kemptville; Lucan; Melbourne; Midland; Orangeville (12 specimens); Penetanguishene; Port Hope; Prescott; Smiths Falls; Trenton; Walkerton; Waterford; Wingham.

Other institutions:—University of Ottawa; Rideau Street Convent, Ottawa; Loretto Abbey (35 specimens), Toronto; Ryerson School, Hamilton.

Province of Quebec—

Laval University, Quebec, 3 specimens; College of Lévis; Classical and Commercial School, Rigaud, 54 specimens; McGill University, Montreal, 21 specimens.

Province of Saskatchewan—

High School:—Moosomin.

*R. L. Broadbent.*

In July I returned from Christchurch, New Zealand, where I had been in charge of the Canadian Mineral Exhibit at the International Exhibition.

While the exhibit there was not as large as those at Liege and Milan, yet it contained by far the largest and most complete collection of economic minerals on display. Of the 14,000 square feet of space allotted to Canada, 3,941 square feet were occupied by the mineral section. The minerals were arranged in table-cases and in pyramids, and where practicable, the various stages of reduction of the ores were illustrated from the raw material as it came from the mine to the finished product and articles manufactured from it.

The large display of silver-cobalt-nickel ore from the Cobalt mining district of Ontario created much interest amongst metallurgists and others interested in mining. The displays of nickel, asbestus, mica, corundum and graphite also attracted a great deal of attention, most of these minerals being novelties in New Zealand. Panels giving mineral statistics and other information in regard to Canadian mining enterprise were placed at various points of vantage.

The exhibition was a pronounced success and will be the means of drawing the peoples of the two Dominions into more intimate relations.

After my return in July I visited the Cobalt, central Ontario and Kingston and

Pembroke districts, and in addition to securing a large number of specimens for the Museum, collected the following materials for the educational collections:—

| | | Pounds. |
|---|---|---|
| Fluorite | Madoc | 525 |
| Talc (white) | Madoc | 850 |
| Hematite | Madoc | 400 |
| Lithographic stone | Marmora | 500 |
| Sodalite | Dungannon | 400 |
| Nephelite | Dungannon | 400 |
| Nephelite-syenite | Dungannon | 400 |
| Garnetiferous schist | Cardiff | 450 |
| Iron pyrites | Queensborough | 500 |
| Arsenopyrite | Deloro | 500 |
| Hornblende | Bridgewater | 600 |
| Actinolite | Bridgewater | 250 |
| Talc (green) | Grimsthorpe | 250 |
| Celestite | Bagot | 600 |
| Graphite | Brougham | 500 |
| Barytocelestite | Loughborough | 450 |
| Chlorite | Belmont | 350 |
| Chlorite-schist | Belmont | 350 |
| Niccolite and smaltite | Cobalt | 500 |
| Native bismuth | Cobalt | 25 specimens |

A series of marbles from the townships of Faraday and Dungannon.

Special thanks are due to Messrs. T. R. Drummond, T. Culbert and T. R. Jones, of Cobalt; to Mr. H. F. Meech, of Calabogie; to Mr. T. Morrison, of Bancroft, and to Messrs. W. S. Morden and A. C. McLatchie, of Belleville, for many courtesies rendered during the season.

*C. W. Willimott.*

During the early part of the year I was engaged chiefly in making up collections of minerals and rocks for distribution to educational institutions in Canada. Considerable time was also consumed in replying to inquiries regarding specimens that had been brought into the Department for identification.

My field work was materially interfered with through ill-health. I visited several localities in the township of Egan, Wright county, Quebec, at which mineral occurrences had been reported, but with one or two exceptions little of note was observed; quartz crystals were found abundantly in the schistose rocks at some points; some of these were very fine specimens; several localities where molybdenite had been found were also examined; development work was in progress at one of these places at the time of my visit; it is doubtful though whether the enclosing rock formation extends for any great distance; at one of the openings a vein of graphite was noticed running parallel with a vein of molybdenite six feet away.

*A. T. McKinnon.*

From June 24 to October 5, I was engaged in collecting minerals for the high school collections, and for this purpose visited a large number of localities in Nova

Scotia, New Brunswick, Quebec and Ontario. The following is a list of my collections for the season:—

| | | Pounds. |
|---|---|---|
| Red sandstone | Amherst, N.S. | 1,100 |
| Bituminous coal | Springfield, N.S. | 243 |
| Moss agate, trap, &c | Two Islands, N.S. | 330 |
| Fibrous gypsum | Moose island, N.S. | 660 |
| Basaltic trap | Two Islands, N.S. | 445 |
| Barite | Five Islands, N.S. | 520 |
| Stibnite | West Gore, N.S. | 125 |
| Manganite | West Gore, N.S. | 75 |
| Siderite | Londonderry, N.S. | 1,300 |
| Limonite | Londonderry, N.S. | 60 |
| Stellarite | Stellarton, N.S. | 200 |
| Selenite | Elmsdale, N.B. | 300 |
| Graphite | Buckingham, Que. | 475 |
| Quartz | Buckingham, Que | 1,000 |
| Apatite | Portland, W., Que. | 475 |
| Scapolite | Grenville, Que | 465 |
| Wollastonite | Grenville, Que | 940 |
| Syenite porphyry | Grenville, Que. | 400 |
| Graphite | Grenville, Que. | 465 |
| Sandstone conglomerate | Soulanges, Que | 480 |
| Magnesite | Bolton, Que. | 525 |
| Chloritic schist | Stukely, Que. | 430 |
| Diopside | Orford, Que. | 450 |
| Calcite | Orford, Que | 460 |
| Pyrite and chalcopyrite | Ascot, Que | 900 |
| Serpentine | Thetford, Que | 400 |
| Chrysotile | Thetford, Que. | 425 |
| Chromite | Coleraine, Que | 500 |
| Bornite in quartz | Leeds, Que. | 675 |
| Limestone | Hull, Que. | 500 |
| Spinel | Bouchette, Que. | 1,575 |
| Jasper | Hull, Que | 325 |
| Marble | Hull, Que | 325 |
| Serpentine limestone | Hull, Que. | 335 |
| Serpentine | Hull, Que. | 335 |
| Marble | Litchfield. | 475 |
| Sphalerite | Calumet island | 600 |
| Albite | Villeneuve, Que | 950 |
| Tourmaline | Villeneuve, Que | 140 |
| Edenite and magnesite | Grenville, Que | 300 |
| Rutile | Templeton, Que. | 200 |
| Idocrase | Templeton, Que. | 375 |
| Sandstone | Nepean, Ont. | 500 |
| Hornblende | Raglan, Ont. | 270 |
| Amazon stone | Cameron. | 500 |
| Fluorite and calcite | Ross, Ont. | 1,040 |
| Perthite | N. Burgess, Ont. | 500 |

In addition to the materials collected as above, Mr. Charles Camsell has collected for this section 280 pounds of silicified wood from Agate hill, B.C.

# MEMORANDUM *RE* COAL TESTS.

*Dr. J. B. Porter.*

A systematic investigation of the coals of the Dominion has been undertaken by the Survey, with the assistance of certain specialists, and sufficient progress has already been made to justify the expectation that the main work on the coals of the Dominion will be completed by the end of next year.

The intention is to obtain a representative sample lot of coal from each important seam in each district, and to subject each of the samples so obtained to an exhaustive series of economic and chemical tests. The economic tests include coal washing, and, when necessary, dry cleaning, followed by boiler tests on the washed and also on the original unwashed coal. Other portions are to be treated in gas producers and the gas used in suitable gas engines provided with devices for measuring the power developed. It is proposed also to carry out competitive coking tests on washed and unwashed portions of such coals as are suitable for the manufacture of coke.

In connexion with the above economic tests a complete series of chemical analyses and calorimetry determinations will be made of all coals, and analyses will also be made of the products of each washing and coking operation and of the gases from the boiler and producer tests.

The Director of the Survey has been able to secure the co-operation of the Mining and Mechanical Engineering Departments of McGill University, and thus to obtain not only competent technical assistance and a trained staff of experts and mechanics, but also to get the free use of admirably equipped laboratories. The advantage of this last feature alone can be judged from the fact that it would cost between $100,000 and $150,000 to duplicate the laboratory and office plants and equipment which have been placed at the service of the Survey. Thanks to these arrangements, it has only been necessary to purchase one considerable set of apparatus, namely, a gas producer and gas engine plant of the most recent type. This has been installed in a temporary fireproof structure, which has been built close to the mining laboratories at McGill. In all other respects it has been only necessary to purchase certain special apparatus to supplement the McGill equipment.

The investigation is under the general direction of Dr. J. B. Porter, Professor of Mining Engineering, McGill University, who is also individually responsible for the sampling, coal washing and chemical work. The conduct of the boiler tests and producer gas engine experiments has been put in the hands of Mr. R. J. Durley, Professor of Mechanical Engineering, McGill University. The several portions of the work are conducted as follows:—

The economic tests above named are carried out on a scale of approximately 50 horse-power and for periods of not less than one day. This 50 horse-power scale has been adopted as being at once large enough to ensure practical service conditions, and

yet small enough to be of value to the community which, in general, makes much more use of small than of large power plants.

Samples are taken by Mr. Theo. Denis, of the permanent staff of the Survey. Mr. Denis visits and examines each mine to be sampled, and has a ten ton lot of coal selected, sacked and shipped under his own personal supervision. In taking this lot he uses every precaution to secure average coal, and, as a check on the main lot, he personally secures a smaller sample which he seals and sends direct to the chemist.

The main sample, on arrival at the testing plant, is unsacked, crushed to go through a two-inch screen, mixed thoroughly, sampled for the chemist, and then re-sacked and set out for treatment.

This work, as well as the washing, the steam, and the gas power tests, is in charge of Mr. C. Landry, Chief Mechanic of the Mining Department.

The coking tests will be deferred until a later date, as it is desirable to first complete the general survey of the subject and analyse and test the coals as above outlined. It is proposed to have the coking experiments done under separate supervision at one of the large modern coking plants, as laboratory tests on coking have not proved reliable even when carried out on a very large scale.

The chemical work is done in Dr. Porter's private laboratory, which has been set aside for this exclusive service. In addition to the regular equipment of the laboratory, calorimeters by Ostwald and Boys have been procured, and such other special apparatus as has been found necessary to make the equipment as complete as possible for investigation on fuels. The chief chemist is Mr. Edgar Stansfield, M. Sc.

Owing to the very tardy deliveries of some of the machinery and apparatus ordered from abroad, and to delays due to the disastrous fires which occurred at McGill last April, it was impossible to get work started as promptly as had been hoped, but, nevertheless, the results for the year are very encouraging. Mr. Denis has visited Nova Scotia and New Brunswick and has taken nineteen samples, all told, aggregating about 175 tons. These samples have all been tested in the boiler plant. Of the coals thus far received twelve have been sufficiently impure to require washing. These twelve have been washed and the washed material tested in the boiler plant.

The gas producing work is not so far advanced, owing to the very late arrival of some of the apparatus, but is now under way (November 1), and will probably be completed before the beginning of the new season.

The work thus done virtually completes the survey of the eastern section, with the one exception of the properties controlled by the Dominion Coal Company, which company did not feel prepared to furnish material for the tests. It is expected to be able to cover the western coal fields next season and also any additional eastern coals which it may be worth examining. It is also hoped that a series of coals from the Dominion collieries may be submitted in order to complete the survey of the country.

In addition to the work above outlined several preliminary samples of western coals have been procured, including lignite from Saskatchewan and anthracite and bituminous coal from Alberta. These samples are now being used in connexion with the development of a producer for dealing with fuels of this character.

In all, counting duplicate runs, there have been completed to date, fourteen washing tests, thirty boiler tests and a very large number of chemical analyses. In addi-

tion to this regular work there have been numerous experimental operations for the purpose of adjusting and testing apparatus and for arriving at standard methods of high accuracy. Probably at least one-half of all of the work done thus far has been of this character.

It may be noted that with the one exception mentioned above, all colliery managers have offered the Department every facility in taking samples and have given the coal free of charge.

The railway companies have hauled the coal free in all cases and have thus relieved the Department from what would otherwise have been a very serious item of expense.

# PALÆONTOLOGY AND ZOOLOGY.

*J. F. Whiteaves.*

In the departments of Palæontology and Zoology, Dr. Whiteaves reports as follows :—

## PALÆONTOLOGY.

'Illustrations of the Fossil Fishes of the Devonian rocks of Canada, Part III., Supplementary.' At the last meeting of the Royal Society of Canada, held at Ottawa in May, 1907, a paper with this title was presented, which has since been printed in its Transactions. All three parts of this paper are devoted to the description and illustration of the remarkable fish faunæ of the Upper Devonian rocks at Scaumenac bay, Que., and of the Lower Devonian rocks at Campbellton, N.B.

The first and second parts, published in the Transactions of the same society for 1886 and 1888, consist of descriptions, with figures, of seven species of fossil fishes from Scaumenac bay (including an extended diagnosis of the then new genus *Eusthenopteron*), and of four species from Campbellton. These descriptions and figures were based exclusively upon collections made by officers of the Survey in 1880-83. Since 1887, large additional collections of the fossil fishes from these two localities have been made by Mr. Jex, for Mr. R. F. Damon, of Weymouth, England (in 1888-92); by Professor W. Patten, of Dartmouth College, Hanover, N.H. (in 1901-02); by Mr. Louis Hussakof, of the American Museum of Natural History, New York City, and by Mr. L. M. Lambe, of this Survey (in 1905). Most of the specimens collected by Mr. Jex have been acquired for the Edinburgh Museum, or for the Geological Department of the British Museum. The specimens now in Edinburgh have been reported on and described by Dr. R. H. Traquair, and those now in the British Museum by Dr. A. Smith Woodward.

The third and concluding part of the 'Illustrations,' which was commenced in 1906, is a synopsis of the latest information about the fossil fishes from Scaumenac bay and Campbellton. It consists of a revised list, with references, of the twenty-two species now known to occur at these localities, with a copy of the original description of each of the genera and species described by Traquair or Smith Woodward, with supplementary notes on some of the species previously described by the writer.

Two palæontological papers have been contributed to the *Ottawa Naturalist* for February and August, 1907. The first of these is entitled 'Notes on the skeleton of a White Whale or Beluga recently discovered in Pleistocene deposits at Pakenham, Ont.' It gives a somewhat more detailed account of this discovery than that in the Summary Report of this Survey for 1906. The second is entitled 'Description of a Canadian species of *Peltoceras*.' The specimen upon which it is based was collected in the Fernie shales at Rocky Mountains park, Alberta, by Mr. D. B. Dowling in 1906. The discovery of an Ammonite of this genus, and the previous recognition of a species of *Cardioceras* in these shales would seem to indicate that they are, in part at least, of Jurassic age.

A commencement has been made of a systematic list, with references, of the fossils of the Corniferous limestone of Ontario, for which material, in the way of specimens, has been accumulating for years. A rough draft has been made of that part of the manuscript which refers to the corals proper, the echinodermata, and the polyzoa or bryozoa.

A revised list of fossils from the supposed Utica or Lorraine shales at St. Bruno mountain, Que., has been prepared for publication in Mr. J. A. Dresser's report. This list is based upon identifications of species that were made in 1906.

Small collections of fossils from various localities have been examined and reported upon provisionally, for members of the staff, employees of the Department and others. Among these collections are the following:—

Fossils from five localities on Cormorant lake near the lower Saskatchewan river, collected by Mr. W. McInnes in 1906; and from the Pasquia hills, Saskatchewan, collected by Mr. McInnes in 1907. The former are clearly of Cambro-Silurian and probably of Trenton age; and the latter as clearly of Cretaceous and probably of Niobrara-Benton age.

Fossils from four localities in the Yukon territory, collected by Mr. Cairnes in 1906, as follows:—From Limestone range, east of Whitehorse; a fragment of a Zaphrentoid or Cyathophylloid coral. From three miles west of De Witte; a few specimens of an Athyroid or Terebratuloid shell, and a fragment of another brachiopod. The coral is evidently a Palæozoic species, and the Athyroid or Terebratuloid shell seems to be of Palæozoic or Triassic age. From Union Mines, twelve miles southwest of Robinson; and from Torie mountain, seven miles west of Robinson. The fossils from these two localities are of Cretaceous age, and apparently indicate the existence of rocks of the same geological horizon as the Fort Benton group of Nebraska, Colorado and New Mexico.

From two localities in the Bulkley valley, B.C., collected by W. W. Leach in 1907. Thirty-five fossils from rocks that are evidently of Lower Cretaceous age.

## PALÆONTOLOGY AND ZOOLOGY.

As it was decided that the General Index, now going through the press, should contain full reference to all the fossils and zoological specimens mentioned in the sixteen volumes, the writer was requested to read all proof containing any mention of palæontological or zoological matter, and to revise the spelling of the family, generic, and specific names therein. The printing of the Index commenced in May, since which time 600 galleys have been received and read.

## ZOOLOGY.

A Bibliography of Canadian Zoology for 1906, exclusive of Entomology, has been prepared for the Transactions of the Royal Society of Canada for 1907, and has since been printed therein.

A paper entitled 'Notes on some Fresh-water shells from Manitoba' has been published in the *Ottawa Naturalist* for March, 1907. The specimens referred to in this paper were collected at two localities by Professor Macoun in 1906.

A list has been made for Mr. McInnes of some fresh-water shells that he collected in 1906; and some recent marine and fresh-water shells from Prince Edward Island

have been named for Mr. Charles Ives, of Miscouche. Information about zoological specimens has been sent to various correspondents.

### DEPARTMENTAL.

During Dr. Low's absence in the field, in the summer months, and during his illness in February and since the middle of September, the duties of Acting Deputy have been performed by the writer, assisted by Mr. Percy Selwyn.

The following specimens were received in 1907, either from members of the staff or from employees of the Survey, in addition to those already mentioned as having been received from Mr. McInnes and Mr. Leach:—

Ells, Dr. R. W.:

About 250 specimens of fossil fishes from the Albert mines, N.B.

Matthew, Dr. G. F.:

Several collections of fossil plants from the north side of the Bay of Fundy, N.B.

Ami, Dr. H. M.:

Fifty fossils (of presumably Upper Carboniferous age), from West Bay, near Parrsborough, N.S.; and about 100 from the volcanic ash beds near the school-house at McAra brook, Antigonish county, N.S.; 100 fossils from the ferruginous beds of the Stonehouse formation (Silurian) along the Arisaig shore, near the contact with the eruptive mass, on McAra brook, below the mouth of Stonehouse brook; and 200 fossils from the Moydart formation along the Arisaig shore, McAra brook.

Twenty-five fossil plants from the coal-measures near Westville, Pictou county, N.S.; and a collection of fossil plants from the Pictou coal basin, near the Vale, the Marsh mine, the Allan shaft, and other localities near Stellarton.

Fossiliferous cores, &c., from the Macnaughton-Fraser bore-hole, on a branch of the Smelt brook near Trenton, Pictou county, N.S.

About 150 fossils from the Silurian limestones at Dalhousie, N.B.; and 100 from the Lower Devonian rocks at Campbellton, N.B.

About fifty fossils from Kennebecasis island, near St. John, N.B.; 200 from various localities in Nova Scotia and New Brunswick; and fifty specimens of plant and fish remains from the Upper Devonian sandstones at Scaumenac bay, P.Q.

Dowling, D. B.:

Twelve fossils from the Lower Cretaceous or Jurassic rocks at the head of Prairie creek, Athabaska river, Alberta.

Malloch, G. S.:

Eight fossils from near the base of the Upper Banff limestones, second range of Rocky mountains, Canadian Rocky Mountains Park, north of Red Deer river; and two fossils from the Lower Banff shale, third range, south of Clearwater river; all from Alberta.

Spreadborough, W.:

Ninety-four skins of mammals, and 172 of birds, from the west coast of Vancouver island. Clutch, of nine eggs, of the Ringed Pheasant; clutch, of two eggs, of the Western Night Hawk; and single egg of the Valley Quail; all from near Victoria, V.I.

Tufts, H. F.:

One hundred and seventy-one skins of birds from Nova Scotia.

Johnston, W. A.:

A collection of fossils from the Peterborough and Simcoe districts of Ontario, including about fifty specimens of Trenton crinoids and starfishes from the vicinity of Kirkfield, Ont.

O'Sullivan, Owen:

Three specimens of a recent marine sponge *(Phakellia ventilabrum)* from low tide at Cape Churchill, Hudson bay.

Young, C. H.:

Specimens of four species of *Sphærium* and one of *Pisidium* from near Ottawa.

The additions to the palæontological and zoological collections in the Museum during 1907, and from other sources, are as follows:—

By presentation:

*(A.—Palæontology.)*

Grant, Colonel C. C., Hamilton, Ont.:

Eighteen fossils from the Niagara formation at Hamilton; one fossil from the Niagara shale at Grimsby; and eighteen fossils from the Cambro-Silurian drift at Winona, Ont.

Narraway, J. E.:

Specimen of *Endoceras proteiforme* (?) from the Utica shale at Cummings Bridge, Carleton county, Ont.

Topley, H. N.:

Small *Inoceramus* from forty-five miles southeast of Medicine Hat, Alberta.

Hatin, A. F., Ottawa:

Small fossil beetle from Lebanon, Syria.

— Milleken, Gleichen, Alberta; per H. N. Topley:

Silicified wood from 100 miles north of Gleichen, on the Red Deer river.

— Hutchins, Winnipeg, Man.; per H. N. Topley:

Specimen of *Receptaculites Oweni*, from the Winnipeg limestone, and of *Streptelasma trilobatum*, from Stony Mountain.

*(B.—Zoology.)*

Weston, T. C., Levis, Que.:

Fossil sponge *(Archæocythus)* from the conglomerate near the street railway sheds at Levis.

Eifrig, Rev. C. W. G., Ottawa:

Posterior portion of cranium of moose (?) with basal portion of antlers, from the bottom of Lake Clear, Sebastopol township, Renfrew county, ten miles south of Eganville, Ont.

Ives, C., Miscouche, P.E.I.:

Eighteen specimens of *Clidiophora Gouldiana*, Dall, from the Miscouche shoals; and eight of *Pisidium Idahoense*, Roper, from a pond at the head of Wilmot river, P.E.I.

Brodie, Dr. W., Toronto:

Specimens of *Sphœrium sulcatum, Anodontoides Ferussaciana,* var. *modesta* (?), and *Unio complanatus,* from Muskoka ; and one specimen of *Pyramidula solitaria* (?), from Moyie, B.C.

By purchase:

Specimen of the large Nova Scotian variety of the Wild Cat (*Lynx rufus,* var. *magnus*).

Black variety of the Chipmunk, from Kingsmere, Que.

Albino Virginian Deer, from North Wakefield, Que.

Two Coyotes, two Rocky Mountain Goats, and one Wolf, from British Columbia.

# VERTEBRATE PALÆONTOLOGY.

*Lawrence M. Lambe (Vertebrate Palæontologist).*

My attention has been given principally, during the past year, to the completion of part IV of Volume III (quarto) of Contributions to Canadian Palæontology. This report on the Vertebrata of the Oligocene deposits of the eastern end of the Cypress hills, Saskatchewan, in and near Bone coulée, is based on the collection made by me in 1904 and on the material of the earlier collections. The report will consist of about one hundred pages of text, illustrated by text figures and seven plates. The manuscript is now ready for the printer, as are also the drawings for the text figures and the plates.

The fauna of the Oligocene deposits of the Cypress hills, made known to us by Professor E. D. Cope's memoir of 1891, has been more than doubled as a result of my study of the collections from Bone coulée. New species, and species previously known but not hitherto recorded from this horizon in Canada, have been added. The majority of these additions have been supplied by the collection of 1904, but a few forms are represented by specimens belonging to the earlier collections from the same locality that apparently were not submitted to Professor Cope for determination. In all over fifty species are described or referred to, belonging to the classes of fishes, reptiles and mammals, the last of these preponderating, the fauna being essentially a land one with the addition of some river species.

These Oligocene beds were evidently deposited by rapidly flowing water from the west. The thick beds of rounded pebbles occurring at the base represent the work of a strong transporting force such as would be supplied by a turbulent stream of considerable size carrying eastward material from the Rocky mountains. The sands show false bedding as a result of varying currents. With the accumulation of material eastward and a consequent reduction of the transporting force, beds of finer material were deposited at a higher level and probably on extensive areas of overflow.

The following papers, of which separates have been distributed by this Department, were published during the year :—

'On a tooth of Ovibos from Pleistocene gravels near Midway, B.C.,' *Ottawa Naturalist,* vol. XXI., with plate.

In this paper an upper molar tooth of a ruminant from Pleistocene gravels on Rock creek about eight miles above its entry into Kettle river, southern British Columbia, is described and figured. The tooth is the right posterior true molar and is referred provisionally to the genus Ovibos. It is compared with the corresponding tooth of *Ovibos moschatus* and *Ovis montana* and references are made to remains of Ovibos previously recorded from Canada.

'On a new Crocodilian genus and species from the Judith River formation of Alberta,' Transactions Royal Society of Canada, third series, vol. I., with five plates.

Certain crocodilian remains including a mandibular ramus, the posterior part of a cranium, part of a maxilla, vertebræ, &c., collected by me from the Judith River (Belly River) formation on Red Deer river, Alberta, are described in detail with ex-

planatory figures, as representing a new genus and species. The name *Leidyosuchus canadensis* is proposed for the genus and species.

Among the characters revealed by the Red Deer river specimens are the following principal ones :—

Mandibular symphysis short and contributed to by the splenial. Alveolar border of mandible undulating. Teeth of unequal size, nearly smooth, with an inner area defined by lateral carinæ, the third lower tooth nearly reaching the size of the enlarged fourth. External mandibular foramen and smaller internal one, present. Orbits confluent with lateral temporal fossae and larger than supratemporal vacuities. Eustachian canals enclosed. Snout, as indicated by the anterior end of a maxilla, short and broad. Fourth lower tooth received into a notch in the maxilla. Vertebræ of the procœlian type. Pits of the sculptured bones of the head and of the scutes, deep and separated by narrow ridges.

These characters indicate a brevirostrate form of Eusuchia, different generically from any hitherto known, and one not readily placed in the present generally accepted classifications of the procœlian crocodilia. It differs entirely from described brevirostrate forms in the entry of the splenial into the formation of the symphysis, a character claimed for the longirostrate forms of the suborder. The dentition of *Leidyosuchus* resembles in some respects that of *Diplocynodon* (Tertiary of Europe and America), especially in the enlargement of the third mandibular tooth. The reception of the fourth lower tooth into a notch in the maxilla is a crocodilian character shared by *Diplocynodon*. The form of the occiput appears to approach closer to that of the crocodiles than the alligators and the size of the supratemporal vacuities is rather crocodilian than otherwise.

As a whole, the characters, brought to light by the specimens on which *Leidyosuchus* is based, place that genus close to those members of the crocodilia having broad, short snouts and procœlian vertebræ. The genus is for the present referred to a group such as would be provided by Lydekker's *Brevirostrate Section* of the crocodilidæ if that section were extended so as to include short-nosed forms in which the splenial enters to a slight extent into the mandibular symphysis.

'Note on the occurrence of a supernumerary tooth in a dog,' *Ottawa Naturalist*, Vol. XXI., with text illustration.

The occurrence of an additional first upper premolar is recorded in the skull of a dog, presumably a collie, found at Tranquille, Kamloops lake, B.C., in 1906. Attention is drawn to the narrow skull and lengthened muzzle in this breed of dog and to its affinity to the wolf in this respect.

No field work was undertaken during the past year, as it was considered desirable to complete work already in hand, more particularly the fourth part of Volume III (quarto) of Contributions to Canadian Palæontology above mentioned.

With a view to enlarging and increasing the usefulness of the present inadequate osteologicial collection, a series of skulls of the small Canadian mammals has been selected from the zoological collection of the Survey, the selection being made by Mr. C. H. Young with the permission of Professor John Macoun. Also a mounted disarticulated skull of *Crocodilus niloticus* has been purchased during the past year. It is hoped in the near future, by additions as occasion permits, to bring together a thoroughly representative collection of the skeletons of all living Canadian vertebrate species to be available for comparison with extinct forms, and for the use of zoologists

and advanced students visiting the Department as well as for exhibition to the general public.

Reference was made in my last year's Summary Report, to the remains of plants and insects included in my 1906 collection of fishes from the Tertiary sedimentary deposits of the southern interior of British Columbia. The determination of the insects has been kindly undertaken by Professor Anton Handlirsch, Adjunct Curator of the Royal Imperial Natural History Museum of Vienna, Austria, a well known authority on fossil insects. The collection was sent to him early in the year and a report on it, for publication by this Department, may be expected soon. The report on the plants, by Professor D. P. Penhallow, of McGill University, Montreal, has been received and is now being printed by the Survey in quarto form. This illustrated memoir, based principally on my collection of 1906, includes collections of former years and brings to date our knowledge of the Tertiary flora of southern British Columbia.

## NATURAL HISTORY BRANCH.

*Prof. John Macoun.*

Owing to the approaching completion of the Victoria Museum, our Director thought it advisable that more of the time and attention of my department should be given to the accumulation and arrangement of our natural history material. With this object in view, arrangements were made in the spring to add to our collection and as far as possible make an inventory of what material we had so that additions could be obtained when necessary and a correct knowledge be had of the material in stock.

Early last spring, Mr. Charles H. Young, whose work as a skilful and artistic mounter of insect specimens is well known, began the preparation of cases illustrating the life history of our large butterflies and moths, and during the summer continued the collection of material to be used for this purpose. Under my directions he has re-sorted, arranged and catalogued our large duplicate collection of birds and mammals. These specimens have all been stored in air-tight boxes, and unless for purposes of comparison will not be disturbed until needed for the new Museum. They include 2,302 bird skins and 1,106 skins of mammals. Of the birds, 463 are waterbirds, including ducks, 82 are waders, grouse and pigeon, 114 are hawks and owls, and 1,653 are small birds. There are 439 large mammals and 667 small ones.

My permanent assistant, Mr. J. M. Macoun, remained in the office all summer, as there was much routine work in arrears, but Mr. H. F. Tufts, in Nova Scotia, and Mr. W. Spreadborough, on Vancouver island, were engaged in collecting birds and mammals; Mr. Tufts for a few weeks in the spring and again this fall; Mr. Spreadborough during the greater part of the season. Both of these gentlemen made large collections which include many rare species.

Since the date of my last report my assistant, Mr. J. M. Macoun, and I have been engaged in the routine work of the branch, except during the three months I was engaged in western Ontario and eastern Quebec. The determination and distribution of plant collections has occupied much of our time. During the year 1,464 sheets of botanical specimens were mounted and added to the herbarium; 2,278 sheets of specimens were received, and 1,593 sent in exchange.

Early in May I received instructions from the Director to obtain photographs of all our forest trees and at the same time secure specimens of our native woods for the Victoria Museum. With these ends in view I went to western Ontario, and in the course of a couple of weeks located numerous remnants of the old forest and discovered where I could obtain museum specimens of the timber. With Mr. H. N. Topley as photographer and John H. Marshall as assistant, I left Ottawa on June 19, and was occupied in the western peninsula of Ontario until July 28, when we returned to Ottawa. During this time we obtained about 130 photographs of forest trees under three conditions—single forest trees, single trees grown in the open and stands of individual trees in the forest. The height and diameter of each tree were determined, and many photographs of trees ranging from 100 to 144 feet in height were taken.

The series of photos. is very fine, and when enlarged and hung in the Museum will not only be very effective, but will be a permanent record of our forest trees and the conditions of the forests at the present time. About forty trees, almost exclusively confined to western Ontario, were photographed, and forty-one tree-trunks, mostly of the same species of trees, were obtained. These were cut five feet long and averaged two feet in diameter. These photographs and wood specimens will form the nucleus of the wood collection for the Victoria Museum. Mr. H. N. Topley had to leave for Calgary, so our work for the season came to an end.

As opportunity offers I am working up the seaweeds of our Atlantic coast, and in the summer of 1905 I spent about five weeks collecting at Cap à l'Aigle below Murray Bay, on the north side of the St. Lawrence, with excellent results. My collections showed that it was actually the Arctic current that flowed up the north shore of the St. Lawrence. Many species collected by me were common on the coast of Greenland. After my return to Ottawa from the west this summer I spent a week in the office and then went to Gaspé basin and Percé, Que., to continue my study of seaweeds. Five weeks were profitably spent and an extensive collection was made. A study of the species found there shows that the water in Gaspé basin is comparatively warm, especially on the Englishtown side. Haldimand beach, near Englishtown, is very extensive and for over a mile there is an excellent beach suitable for bathing purposes. The seaweeds here showed that the cold current found in the St. Lawrence does not reach the beach, and this is the cause of its popularity for summer bathing. The writer ventures to prophesy that on the completion of the Gaspé railway a large summer hotel will be built on or near the beach, and this region will become better known as a summer resort, as there is good bathing, fishing in the sea and rivers, and very safe sailing on the well-sheltered basin.

In this connexion it should be mentioned that Dr. Chas. A. Hamilton, of Mahone Bay, N.S., very kindly offered in the spring of 1906 to make a collection of the seaweeds in that vicinity. A very large series was collected, and his specimens not only form an important contribution to our herbarium, but will be of great value in assisting in working out problems relating to the distribution of marine flora and fauna. The specimens collected at Mahone Bay indicate an inflow of warmer water at that point than is general along the Nova Scotia coast.

While at work in western Ontario and in the vicinity of Gaspé basin a thorough study was made of the flora, both phænogamic and cryptogamic, and large collections were made. These have not yet been worked up but, besides many rare species, several undescribed forms were secured and the geographical limits of many others extended.

Six hundred and fifty-nine official letters were written and about the same number were received.

## THE LIBRARY.

During the twelve months from December 1, 1906, to November 30, 1907, there were distributed 54,781 publications, comprising reports, parts of reports, bulletins and maps; of these, 41,704 were distributed in Canada, the remainder, 13,077, being sent to foreign countries.

The sale of publications during the past twelve months, including reports and maps, amounted to $367.42.

Publications to the number of 3,362 were received as exchanges or donations, including, besides periodicals and maps, reports and publications of foreign Geological Surveys, and memoirs, transactions and proceedings of learned societies in both hemispheres.

As a result of a circular sent to all on the general mailing list, about 15,000 extra copies of the Department's publications were applied for and distributed.

There are now in the library about 16,450 volumes, besides a large number of pamphlets on various subjects.

The number of letters received in connexion with the library was 3,642, besides 3,455 acknowledgments from exchanges and individuals. The number of letters sent from the library was 3,278.

The library is open from 10 a.m. to 4 p.m., for persons wishing to obtain information in regard to scientific matters.

# PUBLISHING DEPARTMENT.

## ENGLISH SECTION.

*F. J. Nicolas.*

The following reports and catalogues have been published since January 1, 1907:—

No. 969. Summary Report for 1906.

971. Mines Section Report for 1905.

Descriptive Catalogue of Minerals and Rocks. By R. A. A. Johnston and Dr. C. A. Young.

899. Part A., Vol. XVI., being the Survey edition of Summary Report for 1904.

902. Report on Brome Mountain, Que. By J. A. Dresser.

942. Report on Peel and Wind Rivers, Yukon. By C. Camsell.
943. Report on Upper Stewart River. By J. Keele. } Bound together.

949. Cascade Coal-field. By D. B. Dowling.

958. Chemistry and Mineralogy (Annual Report). By G. C. Hoffmann.

911. Annual Report (New Series) Vol. XV., (pp. 1025). Containing the following reports:—

(A) Bell, R.—Summary Report of the Acting Director, for 1902.
(AA) Bell, R.—Summary Report of the Acting Director, for 1903.
(F) Dowling, D. B.—Report on Coal-fields of Souris River.
(S) Ingall, E. D.—Report of Section of Mines, 1902.

952. Annual Report (New Series) Vol. XVI., (pp. 733). Containing the following reports:—

(A) Bell, R.—Summary Report of the Acting Director, for 1904.
(B) Ells, R. W.—Report on Graham Island, B.C.
(C) Keele, J.—Report on Upper Stewart River.
(CC) Camsell, C.—Report on Peel and Wind Rivers.
(G) Dresser, J. A.—Geology and Petrography of Brome Mountain.
(H) Young, G. A.—Geology and Petrography of Yamaska Mountain.
(S) Ingall, E. D.—Report of Mines Section, 1903.

977. Report on the Pembroke Sheet. By R. W. Ells.

979. Report on the Klondike Gravels. By R. G. McConnell.

953. The Barytes Deposits of Lake Ainslie and North Chetticamp, N.S. By H. S. Poole.

# PUBLISHING DEPARTMENT.

## FRENCH SECTION.

*M. Sauvalle.*

The following work has been executed during the year:—

Translating part of the 'Cruise of the Neptune,' by A. P. Low (No. 905); editing and publishing (in French) Summary Report of the Geological Survey, 1904; translating and editing Report of Section of Mines, 1904; all aforesaid work having been afterwards transferred to the House of Commons Translating Department, as pertaining to the Sessional Document Service.

**Translating and editing the following reports:—**

No. 995. Report on Chibougamau Region. By A. P. Low.
975. Report on Copper-bearing Rocks of Eastern Townships. By J. A. Dresser.
984. Report on Mineral Pigments of Canada. By C. W. Willimott.
998. Report on Pembroke Sheet. By R. W. Ells.
965. Report on Nickel and Copper Deposits of Sudbury, Ont. By A. E. Barlow.
1016. Report on Gold Values in Klondike High Level Gravels. By R. G. McConnell.

## MAPPING AND ENGRAVING.

*C.-O. Senécal.*

The following is a statement of the work accomplished under the supervision of the Geographer and Chief Draughtsman during the twelve months which have elapsed since December 1, 1906.

Mr. L. N. Richard compiled, traced for engraving, and prepared the colour copy of a geological map of parts of Nanaimo and New Westminster mining divisions of British Columbia, and drew two small maps and a number of diagrams, supplementary to the above, for zinc-cut reproduction. He computed a large number of latitudes and azimuths from observations taken by several field officers, for use on their maps, and spent some time in plotting field notes, &c. The work of laying down geographical projections for the several maps was mostly carried out by Mr. Richard.

Mr. O. E. Prud'homme traced for engraving the map of Conrad and Whitehorse mining district, Yukon; the plan of Malaga gold district, Nova Scotia, that of Brookfield, Nova Scotia, and a cross-section for Manitoulin Island sheet, Ontario. He compiled new surveys made in the vicinity of Cobalt, Ont., for a new edition of the Nipissing and Lake Timiskaming geological sheets, Nos. 131 and 138, Ontario, and prepared the engraver's copy of the same. He traced for photo-lithographing the map of Split Lake-Churchill route, N.W.T., and prepared, for similar reproduction, the copy for a second edition of the map of principal mineral occurrences in New Brunswick. He also prepared the colour copy of the map of Northwestern Ontario, north of Lake Superior. Much time was spent by Mr. Prud'homme in classifying and cataloguing engraved copper plates and lithographic stones, photographic glass negatives, &c.

During the early part of the year Mr. H. Lefebvre assisted Mr. D. B. Dowling in the compilation of a photo-contour map of the coal fields of Alberta. He traced for engraving the maps of Telkwa and Similkameen mining areas, British Columbia, and prepared the colour copy of the Mineral Map of New Brunswick, 2nd edition. Mr. Lefebvre compiled new surveys of Northwestern Quebec for a second edition of the map of the Basin of Nottaway river. This revised map, which entailed almost as much labour as if entirely reconstructed, is nearly ready for the engraver.

Mr. A. Dickison completed the compilation of the two L. Nipigon geological sheets, Nos. 16 and 17, Northwest Ontario series. He assisted Mr. W. H. Boyd in the compilation of two special topographical and geological maps of Rossland and vicinity, British Columbia, and traced the same for engraving. A general geological map of the southeastern portion of Nova Scotia was also prepared from the original published large scale sheets and traced by him for engraving. This map is being revised by Mr. E. R. Faribault. Mr. Dickison also traced for engraving and prepared the colour copy of the map of part of Northwestern Ontario to accompany Mr. W. H. Collins' report, 1906. Mr Dickison devoted also much time on drawings and specifications of a new model of surveying camera.

Mr. G. G. Aitken compiled the preliminary geological map of the Quebec townships adjoining L. Timiskaming, and traced the same for photo-lithographic reproduc-

tion. He prepared the colour copies of the Moose Mountain sheets, Alberta ; traced part of Prospect sheet, No. 69 Nova Scotia, for engraving; prepared title, legends, colour copy, &c., of Map of Coal Areas in Alberta, Saskatchewan and Manitoba, and traced eight diagrams showing the mineral production of Canada for 1906. Mr. Aitken also made corrections and prepared colour work on a map of Templeton district, Quebec. This map was sent back to the geologist for revision. Mr. Aitken has now in hand a photo-lithographic map of Ancient Shore-lines of Eastern Ontario.

Mr. R. B. Yorston was appointed on the temporary staff as draughtsman and reported himself for duty on the 9th of February. He compiled, traced for engraving and prepared colour work of map of Older Copper-bearing Rocks of the Eastern Townships, Que. He drew for photo-lithography the map of Klondike gold-bearing gravels, and traced for engraving the Elmsdale and Prospect sheets, Nos. 66 and 69, of the Nova Scotia geological series. He has now in hand the tracing of the Halifax geological sheet.

Messrs. J. J. McGee, Jr., and J. F. E. Johnston made sundry tracings of railway plans and maps; made pantagraph reductions, blue prints, &c., and attended to the indexing of records, plotting, type-writing and general draughting work passing through the office.

The map work carried out by the several field officers was as follows:—

The map of Klondike gold-bearing gravels, Yukon Territory, on the scale of forty chains to one inch, by Messrs. J. Keele, F. H. Maclaren and F. O'Farrell, under the direction of Mr. R. G. McConnell.

The map of Conrad and Whitehorse mining district, Yukon Territory, on the scale of two miles to an inch, by Mr. D. D. Cairnes.

A map of Whitehorse Copper Belt, Yukon Territory, by Mr. F. H. Maclaren, under direction of Mr. R. G. McConnell.

Two maps of certain mining areas in the vicinity of L. Laberge and Tantalus, Yukon Territory, on the scale of one mile to one inch, by Mr. D. D. Cairnes, assisted by Mr. H. Matheson.

A map of Telkwa River mining region, Skeena district, British Columbia, on the scale of two miles to one inch, by Mr. W. W. Leach.

Two special maps of Rossland, B.C., and vicinity, on the scale of 400 feet and 1,200 feet to one inch, respectively, and progress photographic survey and mapping of the Lardeau sheet, British Columbia, embracing parts of Ainsworth, Lardeau, Trout Lake and Revelstoke mining divisions, on the scale of two miles to one inch, by Mr. W. H. Boyd.

Progress work on the photographic mapping of the coal fields of the Rockies between Red Deer and Clearwater rivers, from Vermilion range eastward, in Alberta, covering an area of about 500 square miles, on the scale of forty chains to one inch, by Mr. G. S. Malloch, under the supervision of Mr. D. B. Dowling.

Compilation of two maps of portions of the Northwest Territories traversed by the proposed Canadian Northern railway, Hudson Bay branch, on the scale of eight miles to one inch, by Messrs. Wm. McInnes and O. O'Sullivan.

A map of a portion of Northwestern Ontario traversed by the National Transcontinental railway, between Nipigon and Sturgeon lakes, on the scale of four miles to one inch, by Mr. W. H. Collins.

Progress mapping of the Simcoe geological sheet, Ontario, on the scale of four miles to one inch, by Mr. W. A. Johnston.

Progress work on map of part of Abitibi district, Quebec, traversed by the National Transcontinental railway, on the scale of four miles to one inch, by Mr. W. H. Wilson.

The compilation of the Kingston and Prince Edward County sheet, the Peterborough sheet and the Eastern sheet of the Dominion map are in the hands of the Geographer of the Department of the Interior.

Progress work on contour map of the City of St. John, N.B., covering an area of about 300 square miles, on the scale of one mile to one inch, by Mr. J. A. Robert, under the direction of Dr. R. W. Ells.

A plan and sections of Brookfield gold district, Nova Scotia, on the scale of 250 feet to one inch, and progress work on sheets Nos. 86, 87, 88, 89, 95 and 96, the first three of which are almost completely compiled on the scale of one mile to one inch, by Mr. E. R. Faribault.

Progress work on compilation of the Nova Scotia geological sheets Nos. 97, 98, 99 and 103 on the scale of one mile to one inch, by Mr. H. F. Tufts, under the direction of Mr. H. Fletcher.

The examination and testing of field instruments and the lists of repairs were attended to by Messrs. D. B. Dowling and W. H. Boyd.

The meetings of the Geographic Board of Canada were regularly attended, and as usual, lists of place-names for our maps were submitted for discussion and approval. Lists of approved names are published in the Annual Report of the Board, and from time to time in the official *Canada Gazette*.

Thirty-three new maps have, during the period covered by this report, been issued to the public (see accompanying list), and fourteen others are at various stages of progress in the hands of the King's Printer.

The total number of specification sheets, memoranda, reports, letters, &c., on subjects relating to mapping and engraving was 153 received and 227 sent.

In closing this statement, I may be allowed to call your attention to the fact that a large quantity of preparatory work for the compilation of maps is now advantageously made by photography. Reductions, enlargements, copies, &c., are done very expeditiously by this method, but the quantity of work increases from year to year, and now that well equipped photographic rooms have been placed at the disposal of the draughtsmen the employment of a professional photographer under my supervision is earnestly recommended.

SESSIONAL PAPER No. 26

The following is a list of the maps, plans, diagrams, &c., the editions of which were received from the King's Printer during the past twelve months:—

| Catalogue Number. | Title. | Area in square miles. |
|---|---|---|
| **938** | Yukon Territory—Geological and topographical Reconnaissance map of Upper Stewart River region. Scale 8 miles to 1 inch | about 5,600 |
| | Alberta—Geological and Topographical map of Cascade Coal Basin, scale 1 mile to 1 inch:— | |
| **929** | Sheet I—Panther river | " 130 |
| **931** | Sheet II—Cascade river | " 176 |
| **933** | Sheet III—Canmore | " 176 |
| **935** | Sheet IV—Wind Mountain | " 176 |
| | Alberta—Topographical map of Cascade Coal Basin, showing coal Areas, scale 1 mile to 1 inch:— | |
| **930** | Sheet 1--Panther river | " 130 |
| **932** | Sheet II—Cascade river | " 176 |
| **934** | Sheet III—Canmore | " 176 |
| **936** | Sheet IV—Wind mountain | " 176 |
| **963** | Alberta—Geological and Topographical map of Moose Mountain region of the 'Disturbed Belt'. Scale 2 miles to 1 inch | " 1,400 |
| **966** | Alberta—Geological and Topographical map of Moose Mountain region of the 'Disturbed Belt', showing Coal Areas, scale 1 mile to 1 inch | " 1,400 |
| **964** | Ontario—Geological map of parts of the District of Algoma and Thunder Bay, scale 8 miles to 1 inch | " 55,000 |
| **770** | Ontario—Geological map of parts of Hastings, Haliburton and Peterborough Counties. Scale 2 miles to 1 inch. (Second edition) | 2,112 |
| **926** | Ontario—Map of the Gorge of Niagara River, showing New Discoveries in the Physics of the Falls. Scale 20 chains to 1 inch | |
| **967** | Ontario—Recession Lines of Niagara Falls, (Revised edition). Scale 200 feet to 1 inch | |
| **944** | Ontario—Preliminary Geological map of Timagami and Rabbit Lakes, District of Nipissing. Scale 1 mile to 1 inch | about 280 |
| **775** | Ontario—Geological map of parts of Sudbury Mining District (Victoria Mines) Scale 1 mile to 1 inch. (Second edition) | 216 |
| **820** | Ontario—Geological map of parts of Sudbury Mining District (Sudbury). Scale 1 mile to 1 inch. (Second edition) | 208 |
| | Ontario—Geological map of parts of Sudbury Mining District (Copper Cliff Mines) (Second edition):— | |
| **824** | North Sheet, Scale 400 feet to 1 inch | about 5 |
| **825** | South Sheet, Scale 400 feet to 1 inch | " 5 |
| **864** | Geological map of parts of Sudbury Mining District (Elsie and Murray Mines) Scale 400 feet to 1 inch. (Second edition) | " 2 |
| **605** | Ontario—Manitoulin Island Geological Sheet No. 126. Scale 4 miles to 1 inch | " 1,800 |
| **660** | Ontario—Pembroke Geological Sheet, No. 122. Scale 4 miles to 1 inch | 3,456 |
| **976** | Quebec—Map of the Older Copper-bearing rocks of the Eastern Townships. Scale 8 miles to 1 inch | |
| **1007** | Quebec—Preliminary Geological map of a Group of Townships adjoining Lake Timiskaming. Scale 2 miles to 1 inch | about 75 |
| **969** | New Brunswick—Map of Principal Mineral occurrences, new edition Scale 16 miles to 1 inch | |
| **927** | Nova Scotia—General map of the province showing the location of Gold Districts. Scale 12 miles to 1 inch | |
| **700** | Nova Scotia—Lawrencetown Geological map-sheet No. 53. Scale 1 mile to 1 inch. | " 80 |
| **807** | Nova Scotia—Musquodoboit Harbour Geological Map-sheet, No. 54. Scale 1 mile to 1 inch | 216 |
| **908** | Nova Scotia—Gay River Geological Map-sheet No. 55. Scale 1 mile to 1 inch | 216 |
| **985** | Nova Scotia—Prospect Geological map-sheet, No. 69. Scale 1 mile to 1 inch | about 80 |
| **937** | Nova Scotia—Plan and section of Leipsigate Gold District, Lunenburg Co. Scale 500 feet to 1 inch | |
| **995** | Nova Scotia—Plan and Section of Malaga Gold District, Queens Co. Scale 250 feet to 1 inch | |

Also, 8 diagrams showing the Mineral Production of Canada and a number of sketch maps and diagrams to illustrate various reports.

## ACCOUNTANT AND SECRETARY'S DEPARTMENT.

*John Marshall.*

During the Session of Parliament, 1906-7, an Act was passed to create a Department of Mines, to consist of two branches, the Mines Branch and the Geological Survey Branch, and in pursuance of the provisions of this Act the Department was placed under the control and management of the Honourable Wm. Templeman, M.P., as Minister of Mines, with Dr. A. P. Low as Deputy Minister, Dr. Eugene Haanel as Director of the Mines Branch, and Mr. John Marshall as chief clerk and accountant. In November Mr. Reginald W. Brock, M.A., was appointed Acting Director of the Geological Survey Branch.

The Dominion of Canada Assay Office, Vancouver, was placed under the control of the Department in May last.

The staff of the Department, including that of the Assay Office, at present employed numbers ninety-three.

During the year the following changes have been made in the permanent staff:—

Dr. G. C. Hoffmann, superannuated.

Dr. A. E. Barlow, resigned.

*Appointments—*

Mr. Walter H. Boyd to the technical class.

Dr. G. A. Young to the technical class.

Mr. M. F. Connor to the technical class.

Mr. F. H. Maclaren to the technical class.

Mr. R. E. Lyons to the junior second-class.

Mrs. Wilhelmina Sparks to the junior second-class.

*Promotions—*

Miss B. Urquhart to the junior second-class.

Mr. F. G. Wait to be chemist to the Department *vice* Dr. Hoffmann.

The funds available for the work and expenditure of the Geological Survey Branch during the nine months ended March 31, 1907, were:—

| Details. | Grant. | Expenditure. |
|---|---|---|
| Civil-list appropriation | $ 52,556 25 | |
| General appropriations | 103,300 00 | |
| Civil-list salaries | | $ 50,687 50 |
| Explorations and surveys | | 50,162 87 |
| Experimental borings for gas, oil, &c. | | 5,012 00 |
| Wages of temporary employees | | 31,009 11 |
| Printing, engraving and lithographing | | 14,060 89 |
| Books and instruments | | 9,696 05 |
| Chemicals and apparatus | | 380 40 |
| Specimens for Museum | | 4,415 00 |

| | | |
|---|---|---|
| Stationery, mapping materials, &c. . . . . | | 3,473 61 |
| Ottawa Exhibition, 1906. . . . . | | 94 31 |
| Incidental and other expenses. . . . . | | 5,964 18 |
| | | $174 955 92 |
| Less—Advanced in 1905-6 on account of 1906-7. | $29,295 75 | |
| Deduct—Unexpended advance credited casual revenue. . . . . | 11 98 | |
| | | 29,283 77 |
| | | $145,672 15 |
| Unexpended balance civil-list appropriation. . . . . | | 1,868 75 |
| Unexpended balances general appropriations. . . . . | | 8,315 35 |
| | $155,856 25 | $155,856 25 |

The correspondence of the Secretarial Department shows a total of 2,085 letters sent, and 2,688 received.

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With the exception of reports by Mr. R. G. McConnell and Mr. Hugh Fletcher, whose results will be published as separates, as quickly as possible, the above Summary Reports cover the work of this Branch during the year November 30, 1906, to November 30, 1907.

I have the honour to be, sir,
Your obedient servant,

R. W. BROCK,
*Acting Director.*

Ottawa, December, 1907.

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